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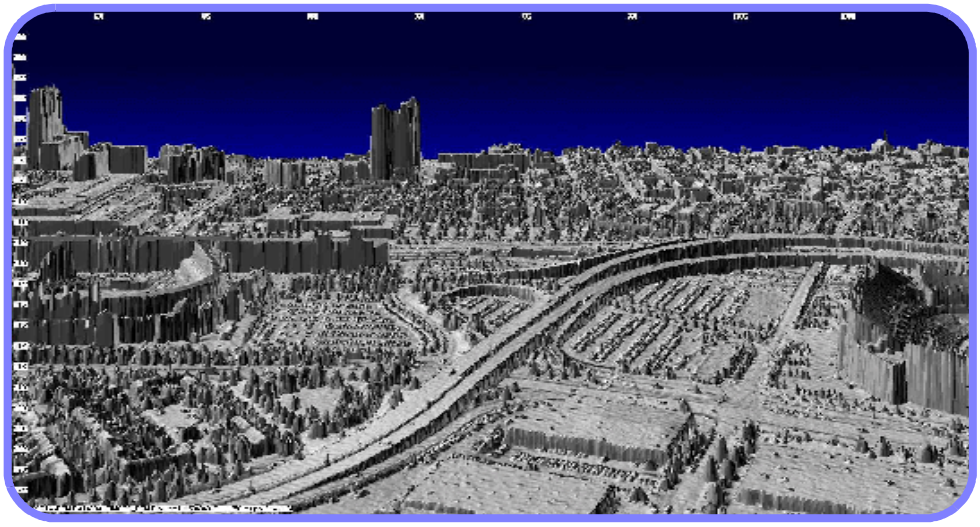

Topographic Operations

Headquarters, Department of the Army

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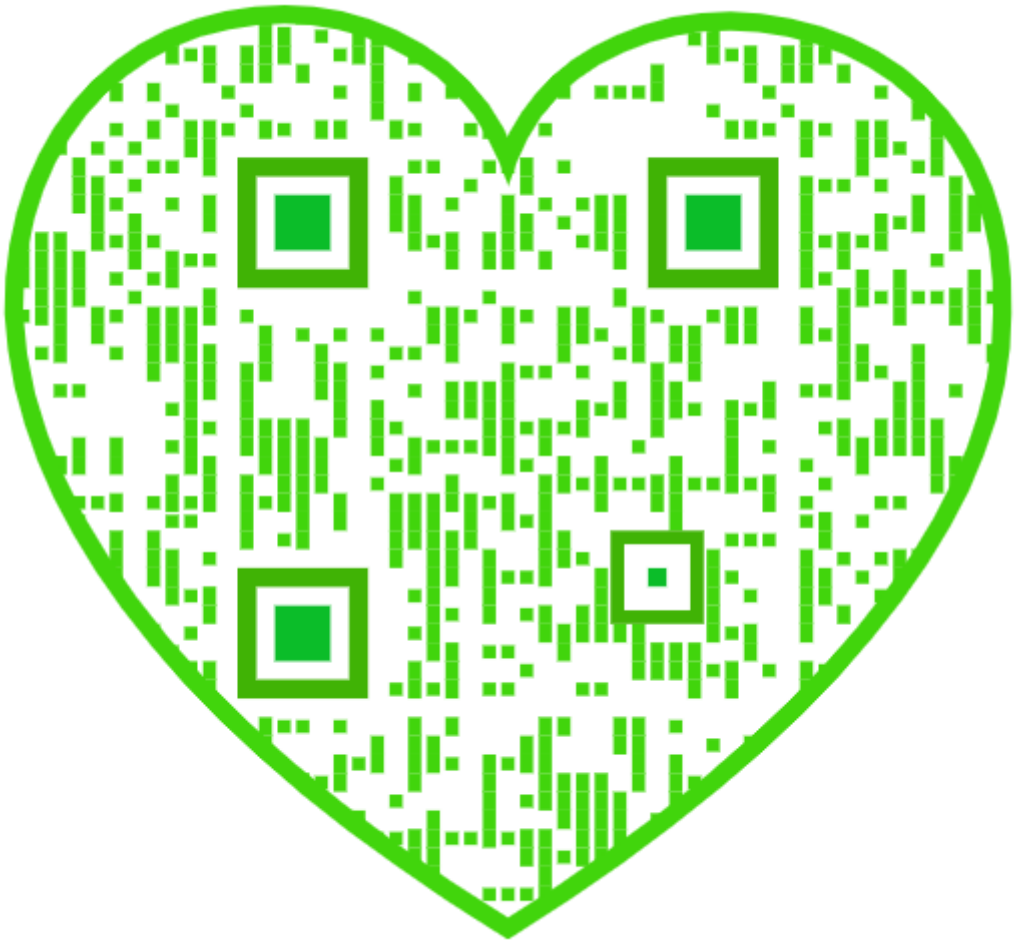

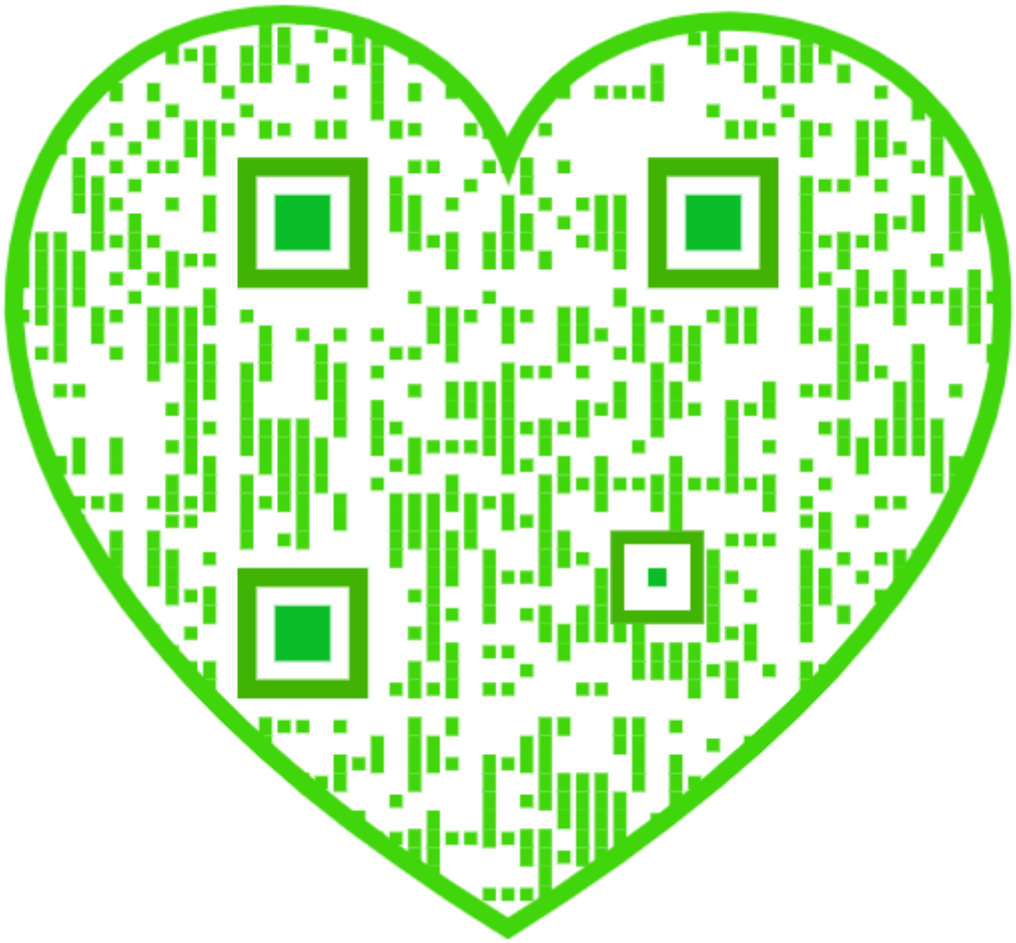

***FM 3-34.230**

Field Manual
No. 3-34.230

Headquarters
Department of the Army
Washington, DC, 3 August 2000

TOPOGRAPHIC OPERATIONS

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Preface

This field manual (FM) describes doctrine for topographic operations in support of the United States (US) Army's strategic, operational, and tactical missions.

The Army's strategic challenge is to prepare for the rise of a major military competitor who is both competent and capable. All topographic operations must rise to the challenges of providing topographic information to a battle commander so that the battle space can be visualized in time, space, and distance. This requires absolute fidelity and definition of the battle space for decision making and mission execution.

Appendix A contains an English-to-metric measurement conversion chart.

The proponent of this publication is HQ TRADOC. Send comments and recommendations on Department of the Army (DA) Form 2028 directly to Commandant, US Army Engineer School (USAES), ATTN: ATSE-DOT-DD, Directorate of Training, 320 Engineer Loop, Suite 336, Fort Leonard Wood, Missouri 65473-8929.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

Introduction

Geospatial information and services (GI&S) incorporate the processes that collect, manage, extract, store, disseminate, and exploit geographic information and imagery. This process is an evolutionary change that reflects the expansion of previous topographic operations within the Army. The GI&S play a significant role in military operations. Geospatial information (GI) provides the foundation upon which all other battle-space information is referenced to form the common operating picture. The GI&S aid the commander in visualizing the battle space to plan and execute military operations effectively, to navigate, and to target the adversary accurately. The GI&S support plays an important role in the full range of military operations; commanders cannot afford to conduct military operations without up-to-date GI.

The GI&S within the future force structure combine the resources of national and commercial capabilities and host nations with the Army topographic-engineering community. This union allows the topographer to provide the battlefield commander a clear understanding of the current state (with relation to the enemy and the environment) and the ability to envision a desired end state (which represents mission accomplishment). The topographer molds the geographic information into map products, tactical decision aids (TDAs), user-defined topographic-analysis products or data sets, and precise geodetic-positioning products. These products can then be digitally transmitted or graphically plotted/ printed to enhance battlefield visualization.

The engineer's GI&S technology is the cornerstone for information dominance that is critical for a smaller, agile, and more lethal army.

Chapter 1

The Army's Operational Concept for Battle Command

Historically, the Army has used the term command and control (C^2) to describe the system that commanders used to plan, direct, coordinate, and control combat operations or other military activities. Because of confusion created by this terminology, the Army now emphasizes that command and control are two distinct, but interdependent, concepts rather than one. The commander and his staff, as a team, use command with control to accomplish the mission.

OVERVIEW

1-1. Battle command is the commander's portion of C^2. Battle command is the art of battle decision making, leading, and controlling operations. It includes—

- Controlling operations and motivating soldiers and their organizations into actions to accomplish missions.
- Visualizing the current and future states, then formulating a concept of the operation to progress from one phase to the other.
- Assigning missions.
- Prioritizing and allocating resources.
- Selecting the critical time and place to act.
- Knowing how and when to make adjustments during the fight.

1-2. Battle command requires the commander to have the mental agility, discipline, and experience necessary to make timely, relevant, and high-payoff decisions; to optimize the force's capabilities; and to control the tempo of mission execution.

ARMY XXI

1-3. Army XXI is the programmed force for the Army in the near-term development cycle. This cycle is undergoing upgrades to existing systems to take advantage of new technologies and opportunities immediately available for organizational improvement. United States Army Training and Doctrine Command (TRADOC) Pamphlet (Pam) 525-5 guides this development and addresses the familiar TRADOC requirements—doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS).

1-4. Since the early 1990s, topographic-engineer units have been receiving more sophisticated equipment for performing GI&S for the Army. This

equipment has been an integral part of experimentation and evaluation to identify the specific functional and operational requirements for Army XXI.

ARMY AFTER NEXT

1-5. The Army After Next (AAN) is about ideas. The AAN project has become a laboratory—part technology oriented, part military-science oriented—in which the Army works with other government services and agencies, academic institutions, and civilian industry to build ideas about the future. The AAN differs from the efforts of other futures groups in that its participants take extra care to subject ideas to both the considered experience of military history and the analytical rigor of state-of-the-art gaming.

BATTLEFIELD OPERATING SYSTEMS

1-6. The tactical level of major war functions—the battlefield operating systems (BOSs)—are those occurring on the battlefield and performed by the force to execute operations (battles and engagements) successfully and to accomplish military objectives directed by the operational commander. The following are the BOSs and some examples of how they relate to topographic operations (refer to Appendix B for examples of standard and nonstandard topographic products as they apply to these systems):

- C^2 (battlefield visualization).
- Intelligence (mobility products and corridors and lines of communication [LOC]).
- Maneuver (bivouac sites, concealment, drop zones, and staging areas).
- Fire support (cover, concealment, mobility, and survey control points [SCPs]).
- Air defense (air avenues of approach, flight-line masking, and target acquisition).
- Mobility/survivability (M/S) (on- and off-road mobility predictions).
- Logistics (information on supply routes, railways, airfields, and storage facilities).

1-7. Topographic units provide support to all BOSs on the battlefield; however, the major emphasis for GI&S support is provided to the intelligence BOS for the intelligence preparation of the battlefield (IPB) and the M&S BOS for the engineer battlefield assessment (EBA).

1-8. The commander directs the intelligence effort by selecting and prioritizing intelligence requirements. These requirements support him in conducting and planning operations. The information he needs to visualize the outcome of current operations is called the commander's critical information requirements (CCIR), which includes information on both friendly and threat forces. The threat-information portion of the CCIR is the commander's priority intelligence requirements (PIR). The CCIR and PIR direct the operations of the topographic unit supporting the commander. In designating PIR, the commander establishes—

- What he wants.
- Why he wants it.

- When he wants it.
- How he wants it.

FUTURE OPERATIONAL CAPABILITIES

1-9. Future operational capabilities (FOC) are statements of operational capabilities required by the Army to develop war-fighting concepts (refer to the TRADOC Pam 525-series) approved by the TRADOC commander. The FOC address specific war-fighting capabilities, not functions or operations. Topographic operations in support of Force XXI and the AAN will be influenced by the integrated FOC, the branch/functional FOC, and the TRADOC-proponent FOC as described in TRADOC Pam 525-66. Refer to Appendix C for more FOC information.

MODELING AND SIMULATIONS/MISSION PLANNING AND REHEARSAL SYSTEMS

1-10. Technology provides the tools to allow a commander to visualize and assess the sequence of actions from the current state to the desired end state. There must be an integrated system to assist him in optimizing mission planning, to facilitate effective rehearsals, and to monitor understanding of his intent before and during mission execution. Training and combat systems must be similar and provide simulation-independent war-fighter descriptions of real-world processes, entities, environments, implementations, and relationships. Software must operate and support live-, virtual-, and constructive-simulation environments to approximate real combat. Technologies, including simulations and artificial intelligence, allow commanders to replicate the real world in an environment where risk is minimal.

1-11. Models and simulations, in conjunction with C^2 systems, are used for training and preparing for combat. Battlefield trends may be assessed rapidly and provide tools for exploring new courses of action (COAs) based on the current situation. A commander uses these tools by applying common sense and experience rather than accepting the computer solution as the best conclusion.

1-12. Military operations make use of modeling and simulation (M&S) applications for creating and analyzing operational plans and orders. Army C^2 systems using M&S applications will facilitate mission rehearsal. These applications must represent combat and the myriad of related support functions with sufficient resolution, fidelity, and detail to ensure high confidence in the results.

BATTLEFIELD VISUALIZATION

1-13. Battlefield visualization is the process whereby the commander develops a clear understanding of the current state with relation to the environment, envisions a desired end state that represents mission accomplishment, then subsequently visualizes the sequence of activity that moves his force from its current state to the end state.

1-14. Battlefield visualization is an essential leadership attribute of command and is critical for accomplishing missions. It is learned and attained through

training, practice, experience, wisdom, and available battle-command technologies. Other resources, both human and technological, serve only to assist a commander in formulating a vision and taking action to implement it. To be successful in battle, a commander must apply experience and intuition to sort through the myriad of information available on the battlefield.

1-15. Battlefield visualization requires the use of operational tools that are derived from science and technology. However, technology alone cannot provide a commander with full battlefield visualization. Technology must be used together with a commander's judgment, wisdom, experience, and intuitive sense to enhance battlefield visualization.

1-16. Battlefield visualization is the heart of battle command. A commander must be able to clearly articulate his battlefield vision to his subordinates in his intent statement. This ensures the optimum development of his concept of operations (see Figure 1-1).

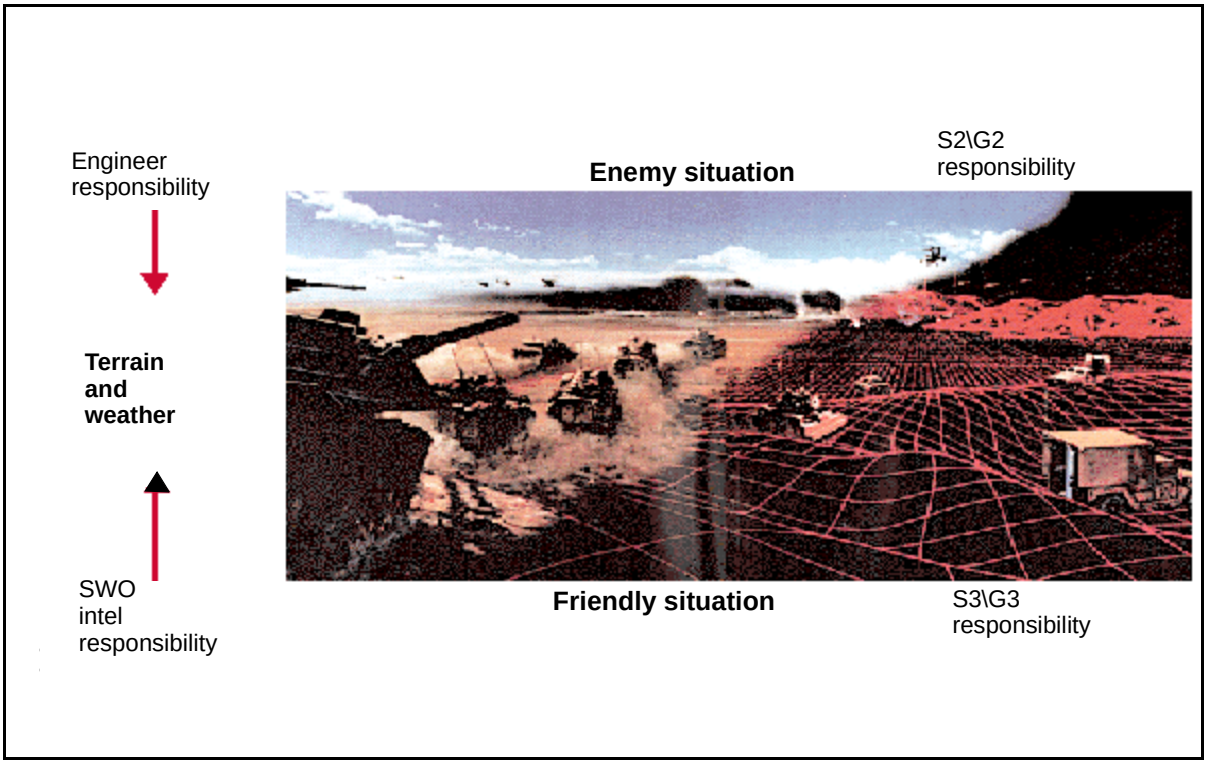


Figure 1-1. Battlefield Visualization

1-17. Battlefield visualization is essential to establishing the battlefield framework as described in FM 71-100. The commander must first gain an understanding of the battlefield. This includes the state of his unit, the state of the enemy, and the impact of terrain and weather. He must then visualize the desired end state and envision a sequence of actions (an intellectual war game) that will cause his forces to arrive at the desired end state.

TERRAIN VISUALIZATION

1-18. Terrain visualization is the process through which a commander sees the terrain and understands its impact on the operation in which he is involved. This includes the impact on both friendly and enemy elements. It is the identification and understanding of terrain aspects that can be exploited by the friendly commander to gain advantage over the enemy as well as those most likely to be used by the enemy. It is the subjective evaluation of the terrain's physical attributes as well as the physical capabilities of vehicles, equipment, and personnel that must cross over and occupy the terrain. Terrain visualization is closer to military art than to military science.

1-19. Terrain visualization is a basic and fundamental leadership skill. A battle commander must understand how terrain influences every aspect of military operations. Commanders require a detailed awareness of the entire situation, including the environment, enemy, and friendly situations.

1-20. Terrain visualization is far from a new requirement. However, in the era of force projection, every means available must be used to provide battle commanders with this fundamental knowledge of terrain while planning for operations. Information technology and force digitization provide a means to that end. Terrain visualization is a component of battlefield visualization. It portrays and allows a detailed understanding of the background upon which enemy and friendly forces and actions are displayed. Topography provides the picture whereby the user can visualize the terrain. Terrain visualization includes the subordinate elements of data collection, database development, analysis, display, distribution, and database management. These elements include both new and changed tasks due to the new way of looking at the battlefield based on digital data. The elements are designed to provide the necessary visualization for the commander and to control and manage a central terrain database. The process of terrain visualization depends highly on joint and combined digital terrain processing means and the uninterrupted electronic transfer of large amounts of information.

1-21. A commander requires the ability to see the battlefield on which his units and the enemy will deploy, maneuver, and fight. The resolution of information demanded increases as the echelon of command decreases. Lower echelons may require slope, elevation, trafficability, vegetation, or natural- and man-made-feature information layers in much more detail. Commanders have traditionally visualized the battlefield's four dimensions (width, depth, height, and time) using traditional two-dimensional paper maps. The current and emerging terrain-visualization tools will enhance the commander's view of the battle space by providing oblique, perspective, and other views in four dimensions.

1-22. Terrain visualization includes both natural and man-made features and the impact of terrain on vehicle speed, maintenance, river-crossing operations, cross-country trafficability, and maneuverability. Terrain-visualization products assist the commander during all phases of the operation. Digitized terrain provides a common terrain background for all users and applications. Additionally, terrain visualization allows interactive planning and mission rehearsal. Terrain-visualization technology must reflect real-time updates as the features change due to the effects of combat and nature.

1-23. Terrain visualization is a significant part of the military decision-making process. In this process, a commander uses the topographic-analysis element within his echelon to collect, analyze, evaluate, and interpret military geographic information on the terrain's natural and man-made features in combination with other factors to provide predictive information and advice about the terrain's effect on military operations. Simply stated, the commander requires topographic analyses to increase his knowledge of the battlefield.

ARMY OPERATIONS

1-24. Operations are designed and conducted to accomplish assigned missions. Army forces conduct operations to compel, deter, reassure, and support. All operations are composed of four basic categories—offense, defense, stability, and support—around which commanders design their operations to achieve victory. The categories of operations apply to both violent and nonviolent environments. The strength in recognizing and employing categories is that they allow a commander operational flexibility in accomplishing a broad range of missions. In training, planning, and executing, this comprehensive view toward operations enables forces to change their focus based on the changing context within which operations are conducted.

OFFENSE

1-25. Offensive operations carry the fight to the enemy. They are decisive operations—the commander's ultimate means of imposing his will on the enemy. Offensive operations combine both force and terrain objectives. There are four general types of offensive operations—

- Movement to contact (MTC).
- Attack.
- Exploitation.
- Pursuit.

DEFENSE

1-26. Defensive operations are those undertaken to cause an enemy's attack to fail. Although they are a stronger category, they cannot achieve a decision alone. Defensive operations must ultimately be combined with or followed by an offensive action. Defensive operations orient on force and terrain. In planning these operations, commanders ordinarily combine three basic types of defensive operations—

- Mobile defense.
- Area defense.
- Retrograde.

STABILITY

1-27. Stability operations apply military power to influence the political environment, facilitate diplomacy, and disrupt specified illegal activities. They include both developmental and coercive actions. Because of their

nature, stability operations complement and are complemented by offensive, defensive, and support operations.

SUPPORT

1-28. Support operations provide essential supplies and services to assist designated groups. They are conducted mainly to relieve suffering and to assist civil authorities in responding to crises. Support operations may be independent actions or they may complement offensive, defensive, and stability operations. The vast majority of offensive, defensive, and stability operations will likely require complementary support operations before, during, and after execution.

1-29. The categories of operations apply to the full range of missions, including large-scale operations against sophisticated mechanized forces; operations to counter insurgencies and terrorism; operations to deter aggression against friendly governments; peace operations; and actions that provide support and assistance. When assigned a mission, a commander analyzes the factors of mission, enemy, terrain, troops, time available, and civilian considerations (METT-TC) to determine how and to what degree he will incorporate the categories into the overall concept of the operation. Commanders use the planning process to determine how best to orchestrate the four operational categories to achieve a desired end state.

Chapter 2

Organizations and Force Structure

The GI&S assets are task-organized (based on METT-TC) to support Army, joint, and combined operations at all levels and throughout the spectrum of conflict. These assets remain flexible to meet mission requirements. Units may deploy in full to support the operation or they may employ split-based operations. The GI&S support for split-based operations requires a robust communications system for transmitting data and products between the deployed element and the split-based element. Split-based logistics include everything from one squad to a company minus the support platoon. In most situations, a squad of terrain analysts and surveyors will deploy into a theater of operations (TO) with the initial-entry force. Additional topographic elements will follow based on the size of force buildup. The entry force will provide rapid-response mapping and TDA support for the task force (TF), while GI&S support will continue from the split-based element using national and commercial sources not readily available to the forward-presence element.

UNIFIED COMMANDS

2-1. Unified and component commanders define military task requirements to support contingency plans (CONPLANs), operation plans (OPLANs), and operations orders (OPORDs) based on the commander's concept of the operation. The corresponding echelon for topographic support and the theater GI&S officer advise the Intelligence Directorate (J2) and other staff officers in preparing the global geospatial information and services (GGI&S) annex for each CONPLAN, OPLAN, or OPORD. The commander outlines the specific support requirements needed for the command.

JOINT TASK FORCE

2-2. Joint task force (JTF) topographic support assets identify GI&S requirements to support OPORDs and coordinate support within their TF. They also collect, review, and validate topographic requirements from component commands. These topographic assets can come from a division, corps, or theater unit, depending on the JTF's task organization.

ARMY FORCES

2-3. Topographic units are task-organized to provide GI&S support for Army forces (ARFOR) in the JTF. This support includes directing, supervising, and coordinating all topographic issues having an impact on the command.

NATIONAL IMAGERY AND MAPPING AGENCY

2-4. The National Imagery and Mapping Agency's (NIMA's) role is to support the war fighter through priorities established by the commanders in chief (CINCs). This support comes in the form of imagery, imagery intelligence, and GI (including standard maps and data sets) in support of national security objectives. The agency's vision is to guarantee ready access to the world's imagery, imagery intelligence, and GI.

2-5. NIMA has technical and liaison representatives at the CINC level who work with the staff and the GI&S officer to establish requirements and priorities and to identify the best products and services that NIMA can provide. These representatives prioritize, validate, and consolidate requirements identified by major subordinate commands (MSCs).

2-6. NIMA has a global mission, as established by the NIMA Act of 1996. It has the unique responsibilities of managing and providing imagery and GI to national policy makers and military forces. NIMA is also an established part of the US intelligence community in recognition of its unique responsibilities and global mission. The agency incorporates the now disestablished Defense Mapping Agency (DMA), the Central Imagery Office, and the Defense Dissemination Program Office in their entirety. It also incorporates the mission and functions of the Central Intelligence Agency's (CIA's) National Photographic Interpretation Center. Also included in NIMA are the imagery exploitation, dissemination, and processing elements of the Defense Intelligence Agency, the National Reconnaissance Office, and the Defense Airborne Reconnaissance Office.

2-7. NIMA brings together in a single organization the imagery tasking, production, exploitation, and dissemination (TPED) responsibilities and the mapping, charting, and geodetic functions of eight separate organizations of the defense and intelligence communities. NIMA continues to improve support to national and military customers through comprehensive management of US imaging and geospatial capabilities.

DEFENSE LOGISTICS AGENCY

2-8. The Defense Logistics Agency (DLA) is a logistics combat-support agency whose primary role is to provide supplies and services to US military forces worldwide. The DLA's mission includes managing over four million consumable items and processing over 30 million annual distribution actions. The DLA manages the inventory of NIMA's hard-copy media (including paper maps, charts, compact disks—read-only memory [CD-ROMs], laser disks, publications, and pamphlets). The DLA processes customer requisitions and inquiries. It is responsible for receipt processing, storing, issuing, packing, shipping, filling subscriptions, and processing customer-unique requirements.

CORPS OF ENGINEERS

2-9. The Engineer Research and Development Center (ERDC) is the US Army Corps of Engineers' (USACE's) distributed research and development command. It consists of eight unique laboratories—five in Vicksburg, Mississippi, and one each in Hanover, New Hampshire; Champaign, Illinois;

and Alexandria, Virginia. The ERDC's headquarters is located in Vicksburg, Mississippi.

2-10. The ERDC provides world-renowned scientists and engineers using the latest in specialized equipment to address problems facing the military and the nation. Research support includes—

- Mapping and topographic analysis.
- Infrastructure design, construction, operations, and maintenance.
- Structural engineering.
- Cold regions and ice engineering.
- Coastal and hydraulic engineering.
- Environmental quality.
- Geotechnical engineering.
- High-performance computing and information technology.

The following are laboratories within the ERDC:

- The Coastal and Hydraulics Laboratory in Vicksburg, Mississippi.
- The Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire.
- The Construction Engineering Research Laboratory in Champaign, Illinois.
- The Environmental Laboratory in Vicksburg, Mississippi.
- The Geotechnical Laboratory in Vicksburg, Mississippi.
- The Information Technology Laboratory in Vicksburg, Mississippi.
- The Structures Laboratory in Vicksburg, Mississippi.
- The Topographic-Engineering Center in Alexandria, Virginia.

TOPOGRAPHIC-ENGINEERING CENTER

2-11. The Topographic-Engineering Center (TEC) in Alexandria, Virginia, provides technical expertise and analytical products that support topographic engineering. The TEC is under the command of the ERDC's commander, who is subordinate to the Commanding General, USACE. The TEC serves as the Army's center of technical expertise on all digital topographic matters. Its mission is to provide the war fighter with a superior knowledge of the battle space and to support the nation's civil and environmental initiatives through research, development, and expertise in the topographic and related sciences. The TEC has 5 major divisions with 16 branches of support.

2-12. The TEC provides a variety of topographic services to the Army along with topographic research, development, testing, evaluation, M&S, and acquisition. The TEC supplies software to support GI&S. It also provides technical support for TEC-developed software, commercial-off-the-shelf (COTS)/nondevelopmental-item hardware, TDA software, survey and positioning systems, digital databases, and digital imagery.

TEC'S COMMERCIAL IMAGERY LIBRARY

2-13. The TEC's Geospatial Information Division (GID) was designated by the Office of the Assistant Chief of Engineers in 1990 to monitor the Army's

commercial/civil imagery (C^2I) acquisition. This action was designed to prevent Army agencies or organizations from duplicating C^2I data purchases.

KEY CAPABILITIES

2-14. Efficient management of the research, acquisition, and distribution of imagery and products is increasingly important as Army units expand their use of this technology, especially with the fielding of the Digital Topographic Support System (DTSS). The GID serves several functions in its role as monitor (as defined in a memorandum of understanding [MOU] between the Army and the US Geological Survey [USGS], dated November 26, 1990). These functions include—

- Acting as the Army's primary point of contact (POC) for C^2I sources to support engineer- and terrain-analysis operations and applications.
- Acting as the monitor for all Army purchases of C^2I.
- Serving as a repository of purchases and scenes available to the Department of Defense (DOD) that are crucial to Army missions.

US ARMY SPACE AND MISSILE COMMAND

2-15. The US Army Space and Missile Defense Command (SMDC) optimizes access to space-based information sources and communication means in support of Army operations. The SMDC uses commercial, foreign, and DOD satellite assets to augment standard topographic data sources and data distribution. Such satellite assets generate responsive data input to the Geographic Information Systems (GISs) operated by Army topographic units. The SMDC serves as the Army's leader for direct downlinking of topographic imagery data as well as the development of tactics, techniques, and procedures (TTPs) on the preprocessing and transfer of remote-sensing data. At the tasking of the DA Deputy Chief of Staff for Operations and Plans (DCSOPS), the Army Space Command (ARSPACE) (located within the SMDC) provides rapid-response imagery. ARSPACE maintains the capability to deploy rapidly with emerging space-based spectral-imagery technology in support of topographic task organizations.

ARMY SERVICE LEVEL

2-16. The Deputy Chief of Staff for Intelligence (DCSINT) at Headquarters, DA (HQDA) is responsible for developing (in coordination with the DCSOPS) topographic plans and programs, identifying and validating Army mapping requirements, and coordinating mapping issues with the Office of the Joint Chiefs of Staff, NIMA, and other DOD organizations. The chief of engineers is responsible for executing the Army's topographic program and providing GI&S advice and technical support to the DA staff (refer to Army Regulation [AR] 115-11 for more information).

TRADOC PROGRAM INTEGRATION OFFICE—TERRAIN DATA

2-17. The TRADOC Program Integration Office (TPIO) acts as the Army's centralized manager for coordinating and synchronizing all Army digital terrain data requirements for digital force development and training,

experimentation, combat developments, and M&S. This mission incorporates the integration, interoperability, and commonality aspects of terrain data and products for the necessary development, testing, production, and fielding of Army systems requiring digital terrain data. The TPIO reports to the Commander, TRADOC through the Commander, US Army Maneuver Support Center (MANSCEN) and the Deputy Commanding General, Combined Arms Center.

2-18. The TPIO will integrate terrain data requirements for live, virtual, and constructive M&S for the training, exercises, and military operations (TEMO); advanced concepts and requirements (ACR); and research, development, and acquisition (RDA) domains.

MANEUVER-SUPPORT BATTLE LABORATORY

2-19. The Maneuver-Support Battle Laboratory's (MSBL's) mission is to be the Army's primary maneuver-support war-fighting experimentation resource. The MSBL integrates experimentation actions across the DTLOMS spectrum and provides enhanced capabilities to soldiers through analyses, insights, and recommendations to the architects of the future army. The MSBL ensures that topography (as a part of maneuver support) is included in all future war-fighting concepts. The lab conducts analyses of experiments to provide input across the DTLOMS spectrum. The MSBL's enduring battlefield function is performing operations to protect the force from the effects of enemy action and providing the force with the freedom of movement during military operations. The enduring battlefield functions of maneuver, fires, battle command, and sustainment all require continuous support from maneuver-support forces that are composed primarily of military police (MP), chemical, and engineer soldiers.

PROGRAM EXECUTIVE OFFICE—COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS

2-20. The Program Executive Office for Command, Control, and Communications Systems ($PEOC^3S$) is the material-developer manager for Army Battlefield Command Systems (ABCSs). This office provides overall architecture-based engineering and integration management and oversight for developing command, control, and communications (C^3) systems throughout each ABCS's life cycle. The DTSS is included within the ABCS to provide geographic information and support services.

PROJECT DIRECTOR, COMBAT TERRAIN INFORMATION SYSTEM

2-21. The Combat Terrain Information System (CTIS) is an Army program managed by the $PEOC^3S$ and colocated at the TEC. The CTIS project director is responsible for project management and the material development and acquisition program for a CTIS. He develops and acquires assigned tactical topographic-support systems that include the following:

- The DTSS-Heavy (DTSS-H).
- The DTSS-Light (DTSS-L).
- The DTSS-Deployable (DTSS-D).
- The DTSS-Base (DTSS-B).

2-22. These systems will enable topographic units to analyze and develop reports and to manage the geographic information database to provide terrain visualization to commanders. The DTSS will also facilitate dissemination of digital and hard-copy topographic products to all battlefield functional areas.

US ARMY ENGINEER SCHOOL

2-23. The USAES located under the MANSCEN is the Army's school for all engineers and is the TRADOC proponent for topography. The engineer component of the MANSCEN is responsible for developing topographic concepts, materiel requirements, combat developments, training requirements, and doctrine for the design of the topographic force structure and all matters related to Army topographers and topographic units.

DEFENSE MAPPING SCHOOL

2-24. The Defense Mapping School (DMS) conducts Army topographic institutional training at all levels with direction from the USAES. Entry-level training is focused on developing basic cartographic and terrain-analysis skills. Midlevel training is focused on managing GI&S data, developing advanced topographic-analysis skills, and generating products. The leadership training is focused on integrating GI&S throughout the military planning and decision-making process. The DMS also provides mobile training teams for sustainment training to the units. It is one of four schools in NIMA's training arm; it falls under the National Imagery and Mapping College (NIMC) located at Fort Belvoir, Virginia.

QUARTERMASTER

2-25. Quartermaster Corps proponent units have the responsibility at all levels for distributing (storage, requisition, processing, and issuance) unclassified standard geospatial products to units that maintain a standard DOD activity address code (DODAAC). Classified products are distributed through logistics units; however, units must have a DODAAC capable of receiving classified documents.

COMMUNICATIONS SYSTEMS

2-26. The signal community is responsible for providing state-of-the-art communication systems for rapidly moving data and products to the maneuver commander. These systems will ensure that the common topographic operating environment (CTOE) is available for every ABCS platform down to the lowest level. The C^2 systems relying on digital geospatial data must receive that data according to procedures established by signal elements.

INTELLIGENCE UNITS

2-27. Intelligence units at all levels are responsible for integrating topographic information into the IPB process and for assisting commanders in the decision-making process. The Assistant Chief of Staff, G2 (Intelligence) (G2) and Intelligence Officer (US Army) (S2) provide a conduit for topographic requirements and priorities for their commanders. The division and corps G2s

and engineers consolidate and prioritize requirements for the division and corps terrain units. Intelligence units also assist in collecting imagery and information to augment the topographic database.

ENGINEERS

2-28. From the Office of Chief of Engineers at HQDA down through the division engineer, the engineer officer has special staff responsibility as the functional proponent for topography and for executing the topographic mission. The terrain-analysis technician (215D) at all echelons is the terrain-analysis and GI&S expert. All engineer officers have topographic expertise in terrain visualization and assist in collection requirements for terrain data to fill data voids in GI&S databases. Engineer officers are responsible for planning and estimating for mobility, countermobility, survivability, and general-engineering missions.

2-29. The echelons-above-corps (EAC) topographic-engineer battalion is the Army Service Component Command (ASCC) topographic asset. The battalion commander is the theater topographic engineer. The battalion has a headquarters and headquarters company (HHC), an EAC topographic-engineer company, and a separate numbered planning and control (P&C) detachment. The EAC company contains terrain-analysis, map- and data-reproduction, data-generation, survey, and database capabilities. The terrain platoon maintains a database for the theater area of operation (AO). The company develops, maintains, disseminates, and deploys the theater's topographic database. This database provides GI&S for EAC commanders. It supports corps-and-below topographic requirements. The P&C detachment locates with the theater headquarters to prioritize topographic requirements. These EAC assets can conduct topographic operations from home-station, split-based logistics, or deployed environments.

Topographic-Engineer Battalion

2-30. The commander of the topographic-engineer battalion at EAC has oversight of all topographic units in the theater. Figures 2-1 and 2-2, pages 2-8 and 2-9, show active topographic companies at the EAC and corps levels. The topographic-engineer battalion commander is responsible for—

- Providing the P&C element to the appropriate theater component staff.
- Providing general support (GS) to unified and specified commands.
- Providing GS to subordinate topographic units for requirements beyond their capability.
- Furnishing topographic support to all Army units at EAC.
- Managing the in-theater, topographic-production program (including topographic databases).
- Generating data.
- Collecting and managing data.
- Providing supply-point storage and distribution of special topographic products at EAC and corps levels.
- Assisting assigned units with topographic technical supplies.
- Providing direct support (DS) and GS maintenance of topographic equipment located at all assigned units.

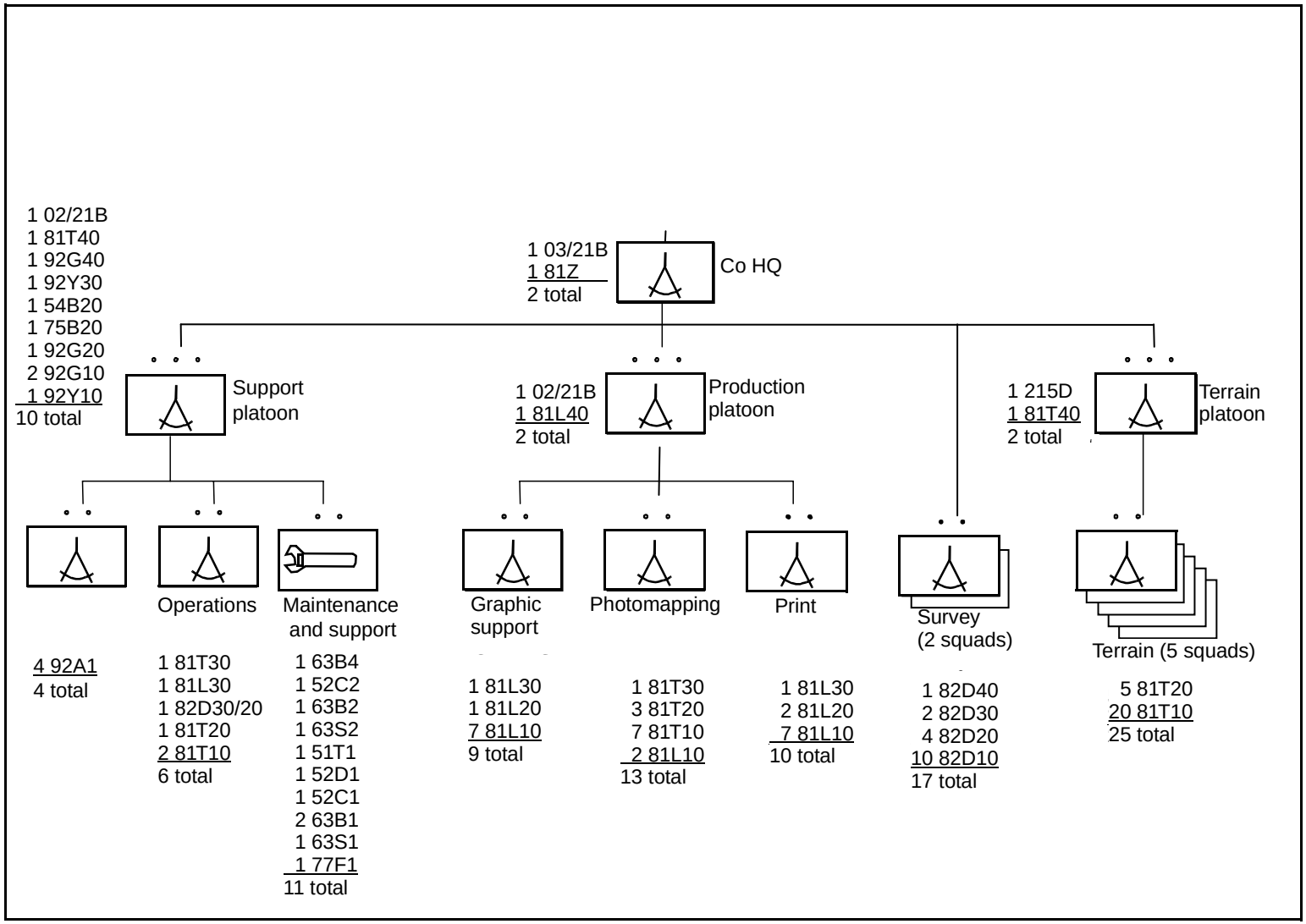


Figure 2-1. EAC Topographic Company

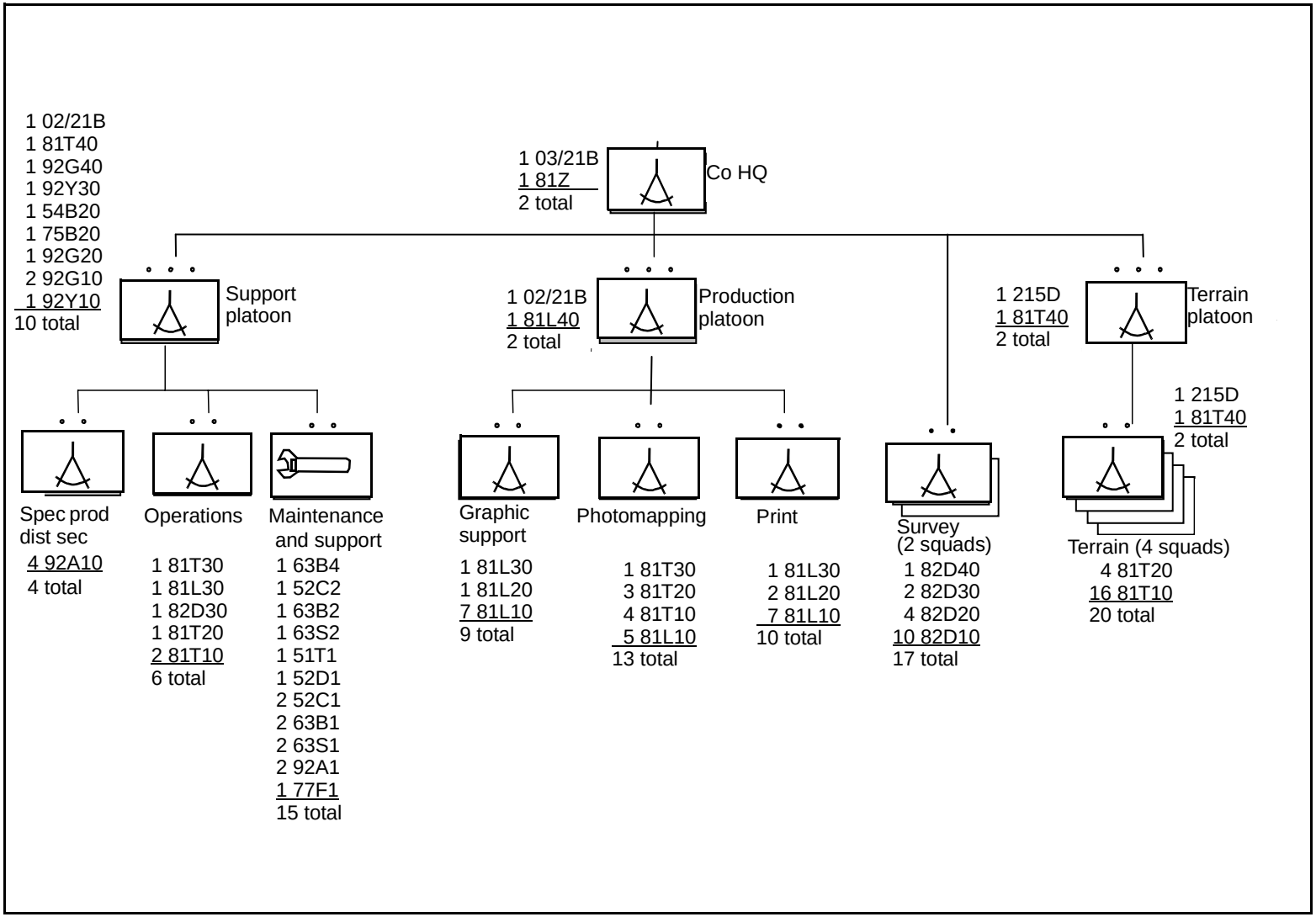


Figure 2-2. Corps Topographic Company

Topographic-Engineer Company

2-31. The corps topographic-engineer company is a DS asset that focuses on the corps's contingency areas. It is responsible for all terrain analysis and GI&S support to the corps. The terrain platoon maintains a database for the corps's area of interest (AOI). The corps company places emphasis on quick-response topographic decision aids and maintains collection and management of the corps database. It conducts topographic operations from a home base or while it is split based or fully deployed. The corps topographic-engineer company works for the corps engineer and provides terrain-analysis and GI&S support to the corps staff and all MSCs. The corps G2 and Assistant Chief of Staff, G3, (Operations and Plans) (G3) are consistently the critical supported staff elements.

Nondigital Division Topographic-Analysis Detachment

2-32. The division topographic-analysis detachment (see Figure 2-3) is responsible for all terrain-analysis and GI&S support to the division (collecting, analyzing, managing, integrating, and disseminating the division's geospatial database). The terrain-analysis detachment is attached to each division. It works with the division staff for planning operations and integrating terrain and GI&S products into the IPB process.

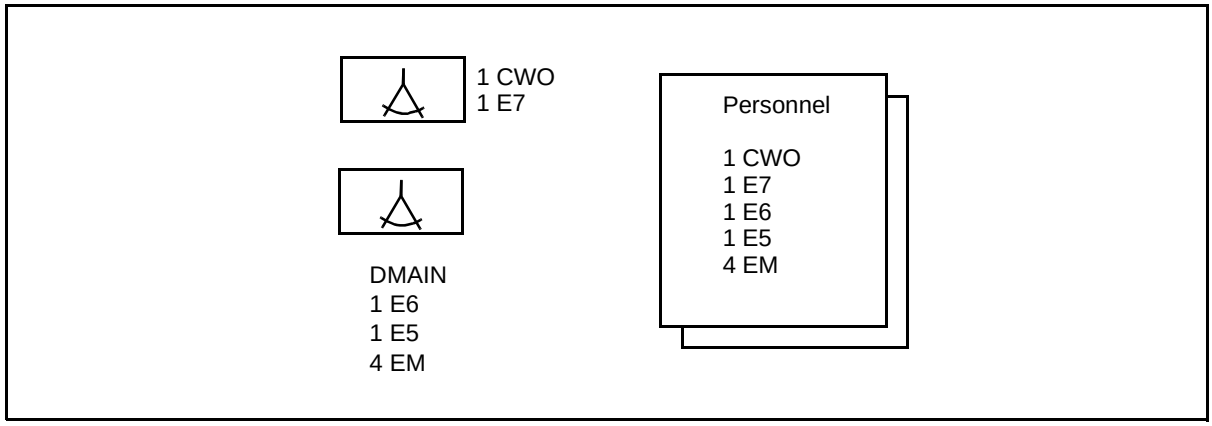


Figure 2-3. Nondigital Division Terrain Detachment

Digital Division Terrain Detachment

2-33. The digital division terrain detachment is responsible for all terrain-analysis and GI&S support to the division. The terrain-analysis detachment is attached to each division. It works for the division engineer and colocates with the planning and operations staff. The terrain-analysis detachment works with the engineer mobility cell for planning operations and integrating the terrain analysis and GI&S into the IPB and EBA processes. The detachment is responsible for collecting, analyzing, managing, integrating, and disseminating the division's GI&S database. The detachment is task-organized into squads to support the division main (DMAIN), the tactical command post (TAC), and the maneuver brigade command posts (CPs) when the division is deployed (see Figure 2-4). These squads will colocate with the

division headquarters in garrison to consolidate efforts to support the division's planning process. When deployed, the squads will provide terrain-analysis and GI&S support to the commander at their echelon through the organic engineer brigades or battalions. They will also maintain the secondary topographic-data storage device. Tailored terrain-analysis products and database management provide brigade and battalion commanders with the CTOE and the effects of terrain and weather on their soldiers, weapons, and tactics.

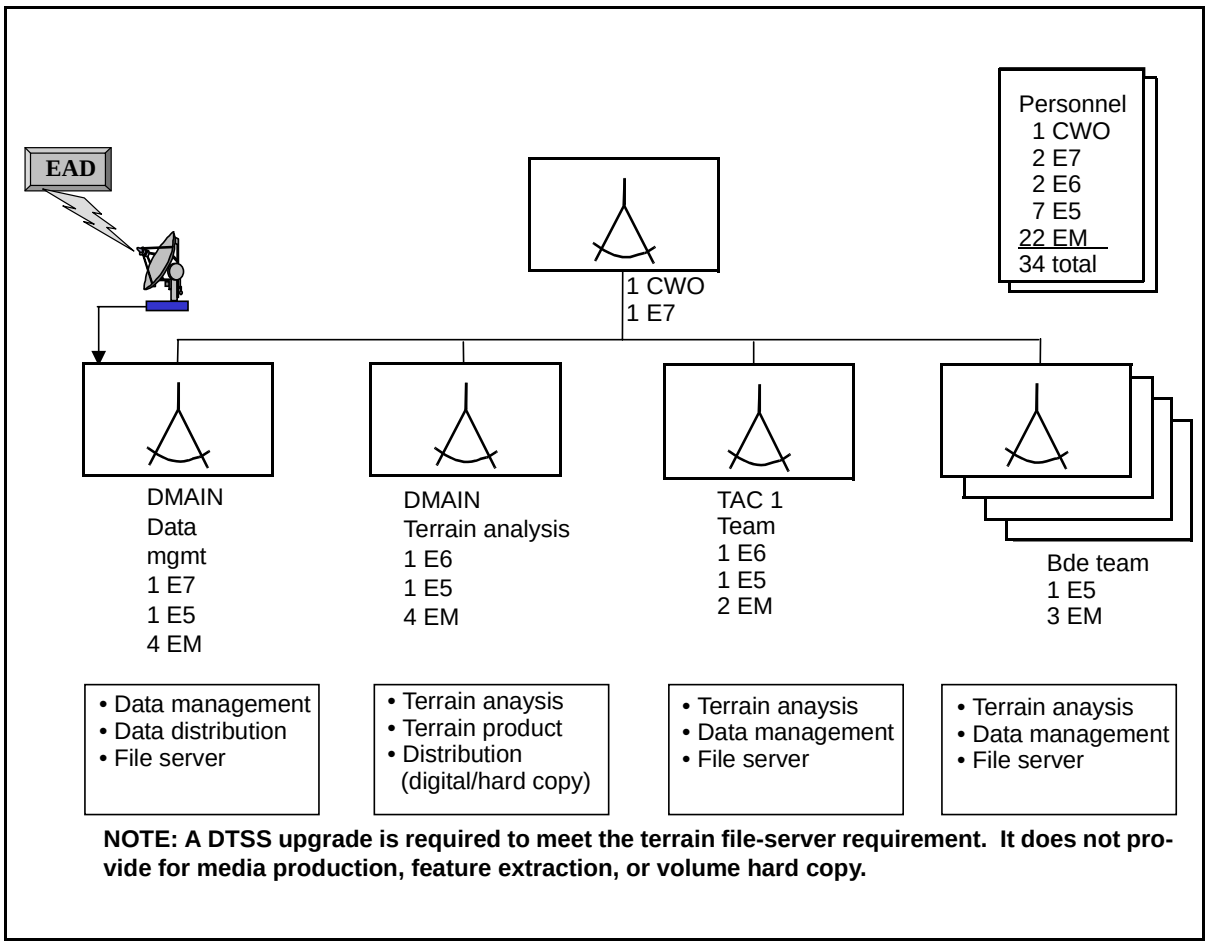


Figure 2-4. Digital Division Terrain Detachment

Chapter 3

Topographic Support

Computer technology has changed the Army's mapping, data-collection, and battlefield-planning processes. As computer power and accessibility have grown during the 1970s and 1980s, new methods of map making and terrain analysis have been developed. Military commanders have long realized the interdependence of the earth's land features and their success on the battlefield. Those military leaders who stand out in history visualized the terrain and its effects on the battle's outcome. Today's topographic engineer (along with his GI&S tools) is able to represent the terrain and its effects more accurately and faster to help the commander visualize the terrain. The commander's knowledge of the terrain will allow him to obtain a superior advantage in shaping the battle space; it is a key portion of information dominance leading to successful operations.

TOPOGRAPHIC SUPPORT PERSONNEL

3-1. The engineer officer at theater, corps, division, and brigade is the terrain-visualization expert. He is responsible for assisting the commander in visualizing the terrain and its impact on friendly and enemy operations. The process includes identifying and understanding those terrain aspects that the commander can exploit to gain advantage over the enemy as well as those that the enemy will most likely exploit. Terrain visualization is a subjective evaluation of the terrain's physical attributes as well as the physical capabilities of the vehicles, equipment, and people that must cross or occupy the terrain. This situational awareness (friendly and enemy elements, terrain, and weather) allows the commander to visualize the battle space.

3-2. The engineer terrain-analysis technician (215D) is the terrain-analysis and GI&S expert within the Army's force structure. His primary function is to help the commander and his staff in understanding the battle space by assimilating and integrating large volumes of geographic information and transforming it into visualization, information, and knowledge.

3-3. The topographic analyst (81T) supervises and/or performs cartographic and terrain-analysis duties. He collects and processes military geographic information from sensed imagery, digital data, intelligence data, existing topographic products, and other collateral data sources; edits cartographic and terrain-analysis products; and advises command and staff officers on topographic operations and special map-product planning.

3-4. The topographic surveyor (82D) conducts precise geodetic surveys to provide control data for a wide range of uses, including precise navigation and artillery fires. The topographic surveyor also supervises topographic or geodetic computations.

3-5. The lithographer (81L) is the large-volume printing expert. He operates and performs operator maintenance on offset duplicators and presses, copy cameras, platemakers, and various types of bindery and film-processing equipment. He also supervises and performs all printing and binding, camera operations, layout, and platemaking activities.

3-6. The topographic-engineering supervisor (81Z) supervises topographic surveying, cartography, and lithographic activities and assists in topographic planning and control activities. The topographic-engineering supervisor determines requirements and provides technical supervision of topographic mapping and other military geographic intelligence programs, including geodetic and topographic surveying. He assists in command supervision and coordination of map reproduction and topographic nonstandard-product distribution. He provides staff supervision and principal noncommissioned officer (NCO) direction to units engaged in performing topographic-engineering missions.

TOPOGRAPHIC OPERATIONS AND FUNCTIONS

3-7. Topographic operations include terrain analysis, geodetic survey, production and reproduction, database management, and exploitation. While each function provides information about the battle space's physical characteristics, the focus of topographic operations is on terrain analysis and the presentation of its results to the commander. Rapid analyses of terrain factors and environmental effects are essential for deploying advanced weapon systems effectively, visualizing the battle space, targeting, planning air and ground missions, and countering enemy weapons and intelligence-collection capabilities. Terrain database management is evolving as another critical GI&S mission. Database management incorporates the collection, production, and dissemination of GI.

3-8. Terrain analysis is the study of the terrain's properties and how they change over time, with use, and under varying weather conditions. Terrain analysis starts with the collection, verification, processing, revision and, in some cases, actual construction of source data. It requires the analysis of climatology (current and forecasted weather conditions), soil conditions, and enemy or friendly vehicle performance metrics. In short, it turns raw data into usable information. Terrain analysis is a technical process and requires the expertise of terrain-analysis technicians (215D) and topographic analysts (81T).

3-9. Terrain evaluation is a subset of terrain analysis that is most amendable to automation due to its focus on raster imagery and gridded elevation data. Terrain evaluation is available to any user of the ABCS at battalion and above. It does not include such in-depth studies as cross-country mobility, which requires the analysis of climatology/current weather conditions, soil conditions, and enemy or friendly vehicle performance metrics. However, terrain evaluation does include the tangible aspects of slope, relief, distance, accessibility, visibility, and cover—the picture a commander could hope to see from a strategically located hill overlooking the battlefield (before digitization).

METT-TC FACTORS

3-10. METT-TC factors must be considered in topographic operations to provide the commander with the correct topographic products and analysis. Since these factors vary in any given situation, the term METT-TC dependent is a common way of denoting that the proper approach to a problem depends on these factors and their interrelationship in that specific situation. The application of METT-TC occurs within each BOS across the entire operational spectrum. The GI&S support detailed in this manual is focused on EAC, the corps, and division through brigade.

COMMAND AND CONTROL

3-11. In the modern battlefield, the magnitude of available information (including geographic information) challenges leaders at all levels. Ultimately, they must assimilate thousands of bits of information to visualize the battlefield, assess the situation, and direct military action to achieve victory. Topographic analysts are an essential link for the commander to visualize the battlefield. Topographic analysts provide the commander's staff with timely GI&S for planning, coordinating, and establishing control measures consistent with the commander's intent. The Army does not fight alone; it integrates its efforts within the theater commander's unified operations along with other services, other national agencies, and allied and coalition forces. This necessitates a common operational picture whose foundation is based on geographic information. The management and exploitation of the terrain database is a topographic-engineer function.

INTELLIGENCE

3-12. Intelligence uses the IPB process to analyze the weather, terrain, and threat in a specific geographic area for all types of operations. The IPB integrates threat doctrine with weather and terrain as they relate to the mission within a specific battlefield environment. This is done to determine and evaluate threat capabilities, vulnerabilities, and probable COAs. This analytical process builds an extensive database for each potential area in which a unit may be required to operate. The IPB determines the impact of the threat, weather, and terrain on operations. The terrain-analysis portion of the IPB process is critical for determining how the enemy will project its forces within the AO and, ultimately, the AOI.

3-13. The IPB supports staff estimates and decision making. Applying the IPB process helps the commander selectively apply and maximize his combat power at critical points in time and space on the battlefield by—

- Determining the threat's likely COA.
- Describing the environment (and its effects) that friendly units are operating within.

The IPB is a continuous process consisting of the following four steps:

- Define the battlefield environment. The G2/S2 identifies the battlefield characteristics that will influence friendly and threat operations. He also establishes the AOI's limits and identifies gaps in current intelligence holdings. To focus the remainder of the IPB process, he

identifies the battlefield characteristics that require in-depth evaluation of their effects on friendly and threat operations (such as terrain, weather, logistical infrastructure, and demographics). These characteristics are analyzed in more detail within the command's AO and battle space.

- Describe the battlefield's effects. The G2/S2 identifies the limitations and opportunities the environment offers for potential operations of friendly and threat forces. This evaluation focuses on the general capabilities of each force until COAs are developed later in the IPB process. This step always includes an examination of terrain and weather, but it may also include discussions of the characteristics of geography and infrastructure and their effects on friendly and threat operations. Products developed in this step might include—
  - A population-status overlay.
  - Overlays that depict the military aspects and effects of terrain.
  - A weather-analysis matrix.
  - Integrated products such as modified combined-obstacle overlays (MCOOs).
- Evaluate the threat. The G2/S2 and his staff analyze the command's intelligence holdings to determine how the threat normally organizes for combat and how it conducts operations under similar circumstances.
- Determine the threat's COA. The G2/S2 integrates the results of the previous steps into a meaningful conclusion. He determines the threat's likely objectives and available COAs given what it normally prefers to do and the effects of the specific environment in which it is currently operating.

MANEUVER, MOBILITY, AND SURVIVABILITY

3-14. GI&S support to maneuver, mobility, and survivability are closely related. Engineers use the EBA as their mission planning and decision-making process. In the IPB phase, the engineer begins with the intelligence assessment of the enemy's objectives, capabilities, and probable COAs. He then analyzes the terrain using the five military aspects of terrain provided by the terrain-analysis unit—observation and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach (OCOKA). His OCOKA analysis is based not only on characteristics of the ground, but also on the enemy and the commander's intent. The engineer assessment produces advice on battle positions and engagement-area siting as well as initial information necessary to develop the obstacle plan and shape the battle space.

3-15. The EBA assesses the following engineer functions:

- Mobility.
- Countermobility.
- Survivability.
- Sustainment engineering.
- Topographic engineering.

3-16. During mission planning, terrain analysts support the EBA and the commander to visualize the battle space by thoroughly portraying the military advantages and disadvantages. The GI&S provide the detailed information necessary to understand the battle space with respect to maneuver, mobility and survivability.

FIRE SUPPORT

3-17. Fire-support (FS) assets in support of maneuver forces include field-artillery (FA) systems, mortars, tactical air units, naval gunfire, Army aviation units, and offensive electronic warfare. Essential topographic support provided to FS assets includes SCPs or TDAs.

3-18. FA survey planning and coordination begin at the corps's artillery survey planning and coordination element (SPCE) with an interface between the topographic engineers and the SPCE at division artillery (DIVARTY) and FA brigades. Army aviation assets are provided topographic support in the form of flight-line-masking, shaded-relief, and vertical-obstruction TDAs. These TDAs support mission planning and rehearsal.

AIR DEFENSE

3-19. Air-defense artillery (ADA) assets protect maneuver forces from enemy air attack. Support provided to ADA assets includes SCPs and TDAs such as—

- Flight-line masking.
- Air avenues of approach.
- Elevation tint.
- Flight-line target locator.
- Obstructed-signal loss.
- Surface-wind direction.
- Visibility.

ADA survey planning and coordination begins at the corps's artillery SPCE, with an interface between the topographic engineers.

LOGISTICS

3-20. Logistics is the provision of personnel, logistics, and other support required for maintaining and prolonging operations or combat until mission accomplishment. The art of logistics is integrating strategic, operational, and tactical support while simultaneously moving units, personnel, equipment, and supplies in timely execution of the commander's intent and his concept of operations.

3-21. Logistics elements are provided with essential topographic information such as—

- LOC TDAs.
- Possible resupply points.
- Assembly-area TDAs.
- Cover-and-concealment TDAs.

- Facilities (seaports, airfields, warehouses, fuel-storage, utilities, medical, financial institutions, and postal systems).

STRATEGIC TOPOGRAPHIC SUPPORT

3-22. Strategic support (as required by national authority) includes GI&S support from NIMA and other national assets. The type and level of support is determined by the mission. It may include standard or nonstandard products provided through the DLA and information provided by NIMA, the TEC, the Defense Intelligence Agency (DIA), host nations, and many other sources. This support is discussed in Chapter 2.

THEATER TOPOGRAPHIC SUPPORT

3-23. Army theater topographic units provide commanders at designated echelons with timely, accurate knowledge of the battle space through terrain visualization. These units support the Army's force-projection mission by rapidly producing special topographic products and maintaining and manipulating topographic databases. Theater topographic units perform terrain analyses, geodetic surveys, and special map reproduction. They also manage the theater-level topographic database.

3-24. The EAC support includes a battalion HHC, a topographic-engineer company providing GS to the theater, and a P&C team located with the Army component command or the JTF. The battalions maintain a strong support relationship with all topographic assets located within their theater and are responsible for assisting in the resupply of their assigned topographic units while deployed.

3-25. The battalion commander is the theater's topographic officer. He recommends the task organization and employment of all topographic assets in the theater. He maintains visibility of all topographic personnel, equipment, logistics, and operations within his theater. He uses his P&C teams to assist with coordinating requirements and recommending priorities for GI&S. The EAC topographic battalion ensures that the full spectrum of functional support is provided within the theater. This support includes—

- Database management.
- Terrain analysis.
- Digital cartography.
- Low-volume product reproduction.
- Topographic survey.
- Reproduction.
- Special-products storage, distribution, and dissemination.

DATABASE MANAGEMENT

3-26. Maintaining a topographic database is a critical function of all topographic operations (refer to Appendix D). Database development and management is a high-priority mission for all topographic units within the theater. GI databases include old data, new data, accurate data, qualified data, and multiformatted hard-copy and digital data. The analyst and the

commander must understand the limitations, accuracy, and intended uses of the GI database. Database management includes the acquisition, manipulation, formatting, storage, and distribution of all hard-copy and digital data and products.

TERRAIN ANALYSIS

3-27. The terrain platoon supports the decision-making process at the theater level by providing the commander with essential decision aids and GI&S. Terrain-analysis platoons at the theater level are primarily focused on providing terrain analysis across the entire theater operational spectrum. This support is initially one level above corps. This enables the planners to identify key areas to enhance and focus the terrain platoon's in-depth analysis and collection efforts. Terrain analysis is the primary mission of topographic operations during the planning phase. The analysis uses a series of feature layers collected at the appropriate resolution and detail to describe the battle space. The analysts modify and update the database using data available from all sources (national and locally collected). This allows the analyst to supply a current picture of the battle space. Appendix B provides a representative list of topographic products that support an analysis of the military aspects of terrain.

DIGITAL CARTOGRAPHY

3-28. Digital cartography is the process of displaying terrain features and elevation data using standard symbology understood by military forces. It uses computer hardware and software to automate the process.

LOW-VOLUME PRODUCT REPRODUCTION

3-29. Low-volume product reproduction is the hard-copy production of maps and GI products using the terrain platoon's organic printing capabilities. The volume is usually less than 200 copies per product. These products are normally distributed over the counter to the requestor.

TOPOGRAPHIC SURVEY

3-30. Topographic survey is the process of determining the relative positions of points on, above, or beneath the earth's surface by using traditional or satellite-based measurement systems. Theater topographic-survey platoons may be tasked with a number of different missions to support terrain platoons, FA, Army aviation, ADA, intelligence, chemical, armor, combat service support (CSS), signal, US Air Force (USAF), or NIMA. Topographic-survey support is discussed in depth in FM 5-532.

REPRODUCTION

3-31. Reproduction is the process of creating hard-copy maps and GI products from original drawings, reproduction materials (repro mats), or images. The theater production platoon uses its organic graphic support, photomapping, and printing capabilities to produce high volumes of hard-copy mapping products. A topographic unit's reproduction equipment includes, but is not limited to—

- Single-color lithographic presses.
- A DTSS.
- Xerographic-type (black-and-white) copiers and laser or bubble-jet color copiers.
- Color plotters.
- Digital-film processors.

3-32. Lithographic presses are used for high volume (over 5,000 copies) monochrome and multicolor printing of standard-size map products (22 1/2 x 29 1/2 inches). The time required for printing increases with each additional color. Time constraints may make multicolor products impractical. NIMA is responsible for printing and the DLA is responsible for distributing bulk map products. Army quartermaster units are responsible for distribution at the operational and tactical levels as a routine supply activity. Theater-level topographic units are responsible for providing digital and hard-copy nonstandard products to theater customers. Dissemination of nonstandard products to theater customers will be accomplished in the most expeditious manner (electronically, through normal supply channels, intelligence channels, or customer pick up). Production assets provide—

- Map substitutes (including image- and vector-based maps).
- Expedient revisions or updates to topographic data.
- Studies of terrain-analysis overlays and graphics.
- Special-purpose products (see Appendix B).
- Geodetic survey and precise positions.
- Digital data (transform, develop, or duplicate).
- Map overprints.

SPECIAL-PRODUCTS STORAGE, DISTRIBUTION, AND DISSEMINATION

3-33. The theater production element may produce large-volume special products for command-wide distribution. These products will be distributed through the supply system with a national stock number (NSN). Low-volume (less than 200) and medium-volume (200 to 1,000) products will be distributed by the most expeditious means (not to exclude the Army's supply system).

CORPS TOPOGRAPHIC SUPPORT

3-34. The senior corps engineer is responsible for all engineer matters, including topographic engineering. The senior topographic commander assigned to the corps is the corps topographic officer. He is responsible for—

- Coordinating corps GI&S requirements for terrain analysis, database management, production, and survey.
- Tasking and prioritizing the corps topographic company's work effort in DS of the corps.
- Facilitating the corps topographic company's DS to the G3/G2.
- Managing, collecting, maintaining, and distributing the corps's digital topographic database.
- Coordinating with the corps G3/G2 for collecting terrain information, as required.

- Preparing the topographic annex or appendix to corps plans and orders.
- Assisting the G2 in defining requirements for topographic products to support the corps.
- Providing production (printing) and survey assistance for the rapid replication of topographic products.

3-35. Topographic support at the corps level consists of a company-sized element in a DS role. This element's capabilities include the same full spectrum of topographic support as the battalion with the exception of the DTSS-B and its production capabilities. The company is task-organized by the corps engineer and receives missions through the assistant corps engineer (ACE). The corps topographic-company commander serves as the corps topographic officer, assisted by the corps GI&S officer assigned to the corps engineer staff section. A company's terrain-analysis platoon provides DS and GS to the corps by performing terrain analyses and furnishing rapid-response and special-purpose GI&S to the corps staff. This facilitates current and future operations, plans, and corps-level maintenance of the CTOE. The corps's printing assets are centrally located to optimize production support. Corps surveyors normally operate throughout the corps's AO.

3-36. The company may task-organize in support of a division or TF for a limited time or in support of a particular tactical operation. Requirements that exceed the capability of corps topographic assets are referred to the EAC topographic battalion. If the distance from the battalion or the tactical situation dictates, the corps may receive an attached portion of an EAC topographic company.

3-37. The corps topographic company ensures that the full spectrum of functional support is provided within the corps's area. This support includes—

- Database management. Maintaining the corps's database includes development and management for all topographic units within the corps. The database functions of the corps topographers mirror those of the theater. The capability to produce GI&S data at the corps level is much more robust than at the division level. As with theater topographic operations, corps topographic units provide GI&S to the corps's force-protection and force-projection missions by rapidly developing, maintaining, and manipulating GI databases and by producing special topographic products. Refer to Appendix D for a detailed description of database management.
- Terrain analysis. The terrain platoon at the corps level supports the decision-making process. It provides TDAs for the corps commander and staff to use in mission analysis, COA development, and the preparation of annexes or appendixes to orders. This tasking usually comes through the ACE staff. Terrain-analysis platoons at the operational level are primarily focused on planning and supporting multidivisional or TF operations. This support is a refinement of the theater or EAC analysis and collection efforts. Incorporating the EAC analysis with the corps analysis enables the planners to identify initial requirements for GI data and products needed through the corps for the operation. Appendix B provides a representative list of terrain

products that support an analysis of the military aspects of terrain, which is not all-inclusive.

- Decision aids. Decision aids are a basic part of the corps IPB and EBA analyses. They are rapidly created for quick integration with other intelligence products. This facilitates the corps intelligence and engineer operations planning for analyzing the AO. The terrain analyst analyzes the battlefield terrain and the effects of weather and the environment to predict terrain impacts on military operations. An intelligence order-of-battle analyst correlates the work accomplished by the terrain analyst with aspects of terrain and enemy combat-systems capabilities to analyze the military aspects of terrain (OCOKA). Together, these two analysts provide the tactical commander with more valuable information than either could provide separately. Analysts at the corps level may also augment a division terrain team with products, data, equipment, and soldiers.

3-38. The following corps functions and capabilities are the same as those in the theater:

- Digital cartography.
- Low-volume product reproduction.
- Topographic survey.
- Reproduction.
- Special-product distribution and dissemination.

DIVISION TOPOGRAPHIC SUPPORT

3-39. The senior division engineer is responsible to the division commander for all engineer matters, including topographic engineering. He is responsible for tasking and prioritizing the division terrain detachment's topographic work effort in DS of the division. The division engineer and the assistant brigade engineer are the focal point for assessing the terrain's impact on current and future operations based on the terrain detachment's GI&S products. The senior topographic commander assigned to the division is the division topographic officer (terrain detachment commander). The division topographic officer is responsible for—

- Coordinating and managing division GI&S requirements for terrain-analysis database management and production.
- Managing, collecting, maintaining, and distributing the detachment's digital topographic database.
- Coordinating with the division G3/G2 for collecting terrain information (as required).
- Preparing the topographic annex or appendix to division plans and orders and coordinating with the G2 in defining requirements and requesting topographic products to support the division.
- Recommending to the division engineer task organization to support maneuver brigades and the division tactical operations cell or other division elements (as required).

3-40. Topographic terrain detachments are structured to support heavy or light infantry forces. The detachments' main functions are performing terrain

analyses, developing GI products, managing topographic databases, and disseminating GI products.

3-41. In the heavy digital division, the detachment commander will task-organize the detachment into elements that support division and brigade CPs and their commanders. The data-management and terrain-analysis element at the DMAIN and the topographic terrain elements at brigade provide support in the areas of—

- Database enhancement.
- Database management and maintenance.
- Database integration.
- Topographic production.
- Terrain analysis.
- GI&S products.

3-42. The data-management element, the terrain-analysis element, and brigade terrain elements are equipped with the DTSS. This system incorporates advanced GIS computing, data management, printing and plotting, and scanning technologies into a single system that is tactically mobile. It provides a means of producing a variety of GI products with terrain-analysis algorithms. The DTSS can produce multiple low-volume (less than 200 copies), full-color, hard-copy products of the battlefield's terrain as well as electronic displays.

3-43. The division terrain-analysis detachment provides the following support:

- Database management.
- Topographic database development (predeployment).
- Terrain analysis.
- Topographic survey.
- Topographic production.

DATABASE MANAGEMENT

3-44. Topographic units must be prepared to create databases rapidly to support current and contingency operations. With strides made in ABCS interoperability and connectivity, topographic units can digitally acquire and share standard GI data for these operations. However, the primary responsibility for collecting and processing the CTOE database rests with the theater and corps topographic companies.

3-45. Topographic units will prepare for tactical-operations support by acquiring GI and loading it into the primary and secondary servers containing the master databases well before the supported unit deploys to its AO or contingency area. Close coordination and working interfaces should be established with the intelligence staff to ensure access and acquisition of imagery data through national imagery and other intelligence data sources early in the crisis.

3-46. The terrain-analysis detachment commander and the brigade terrain squad NCO must establish a close working relationship with the division engineer and the assistant brigade engineer to develop and practice TTP

related to the production and dissemination of GI&S. This interoperability with tactical engineer elements will ensure that terrain products and analytical data are rapidly disseminated to the supported end users.

3-47. Database development and maintenance is an ongoing process. This important function of the engineer terrain-analysis detachment is detailed to the data-management element. The data-management element of the division's terrain detachment acquires terrain data, digital maps, and other topographic information from all sources, both above and below division. The initial division topographic database may be acquired and built using data from the corps topographic company and other national or Army agency data sources during predeployment operations. However, once deployed, it is the responsibility of the terrain detachment's data-management element to manage the secondary map file server and to maintain the division's digital terrain data and products. This includes the digital maps used by the division's ABCS. Through the management and dissemination of this information, the database-management element enables the ABCS operators to evaluate the terrain using the embedded mapping tool kit.

3-48. The division's terrain-analysis detachment continuously acquires as much terrain data as possible over the division's prospective AO and all contingency missions to support operations within the AO. NIMA is responsible for producing digital databases, foundation data (FD), and mission-specific data sets (MSDSs). The division's terrain detachment uses these databases to support the needs of the staff and maneuver commanders. In any area of the world where coverage is not available and the commander's OPLAN considers the area operationally significant, the topographic terrain detachment must gather digital and hard-copy data relevant to that location for storage in the terrain database.

3-49. The terrain-analysis element will identify terrain-data requirements and develop the terrain database using the operational requirements cited by the division and subordinate commander as prioritized by the division engineer. The terrain-analysis database also contains other information as deemed appropriate by the terrain-detachment commander. NIMA and the TEC provide information appropriate for this database.

3-50. Geographic information is exchanged between division, corps, and theater topographic units. This data may then be transferred to the various DTSS workstations at the DMAIN, the division tactical-analysis cell (DTAC), and brigade CPs via signal assets. The detachment commander has the overall responsibility for establishing the TTP and standing operating procedures (SOPs) that address the means by which the database is populated. For example, as new terrain data is obtained and topographic products are created, the data should be checked, validated, and cataloged using uniform naming conventions to facilitate the use of the database. This provides the division's ABCS users with easy access to the GI database residing on the DTSS and Maneuver Control System (MCS) servers.

3-51. The division engineer or the assistant division engineer (ADE), in coordination with the G2/G3, oversees the data-management element located at the DMAIN's mobility cell during garrison operations and following deployment. The noncommissioned officer in charge (NCOIC) of the data-

management element manages the terrain-data file server. He oversees and directs the topographic analysts in the population, update, and archival of terrain databases. He assists in TTP and SOP development and enforces policy related to filing, formatting, storing, retrieving, and archiving the digital terrain data acquired for all topographic elements of the command. He coordinates with the division engineer to set production and dissemination priorities for topographical folders or products based on division staff and maneuver brigade requirements. The topographic NCO at the brigade's tactical operations center (TOC) follows the established TTP and SOP for managing and updating his GI database. He coordinates with the database-management NCOIC and the brigade engineer.

TOPOGRAPHIC DATABASE DEVELOPMENT (PREDEPLOYMENT)

3-52. The majority of topographic-database development begins during an operation's predeployment phase. During this phase, the topographic engineer's primary mission is gaining maximum knowledge of the potential AO and AOI. If additional information is needed, corps and theater support may be required to satisfy database deficiencies. This database provides the basic reference for the production of special-purpose GI to support the tactical commander's planning requirements. See Appendix B for database composition.

3-53. Following deployment, enrichment data will be collected using all available information. The objective is to collect and produce topographic products rapidly to support the continuing IPB and EBA processes. The division engineer works closely with the G2 and G3 during this phase to ensure that sensors and reconnaissance assets are provided to enrich terrain data and information relative to mobility and countermobility operations.

3-54. Enriched data is that which is generated to update NIMA, theater, EAC, corps, and division topographic databases. Enriched data is driven from the top down or bottom up. Top-down GI feeds are primarily changes received from multiple sources that will change or modify GI. Bottom-up GI feeds are primarily those that contribute to the modification of GI and are provided via tactical organizations (such as engineer reconnaissance elements, air and ground scouts, division cavalry, brigade reconnaissance troops, and aerial sensors) using systems such as—

- Ground reconnaissance.
- The unmanned airborne vehicle (UAV).
- The Long-Range Acquisition System (LRAS).
- Other engineer sources (such as corps engineer survey teams).
- Imagery intelligence (IMINT) or human intelligence (HUMINT) sources.
- The Comanche.
- The Longbow Apache.

3-55. Enrichment data retrieved from tactical units is normally provided via verbal or digital reports or imagery to the supported maneuver unit's TOC. At the brigade-level TOC, the brigade engineer or topographic analyst receives this information. Decisions regarding data validity lie with the ADE; quality assurance lies with the G2. Once decisions are made about data validity or

quality, the database manager will then update the master database (as required by the TTP or the SOP) and pass the updated data to the next highest level for inclusion to its master database.

3-56. The division terrain team at the DMAIN's mobility cell consolidates the enrichment data forwarded by the division's tactical elements. The consolidation process consists of organizing the data to present a CTOE at each command level served. For example, a brigade report to the division that shows individual minefields will be consolidated. Once consolidated with terrain data, the information presented on a combined-obstacle overlay presents a complete picture related to mobility restrictions within the division's AO or individual brigade sectors.

3-57. When operating with nondigitized units, the division's terrain team works closely with the division engineer and the assistant brigade engineer to develop unique TTP and operational SOPs that define the methods by which information updates are disseminated. This coordination must occur to ensure data integrity with all supported elements of the division.

3-58. The Database Management System (DBMS) is an automated tool provided to the analyst. It is a complex set of software programs embedded within the DTSS to assist the analyst in controlling the organization, storage, and retrieval of data suborganized by file and recorded in a database. It also provides database security, thereby ensuring integrity. The DBMS automatically correlates data from various sources, enabling the analyst to manipulate the data to create and disseminate new or updated topographical products. The DBMS also facilitates the exchange or addition of new categories of data, such as digital maps or overlays, without major disruptions to ongoing work.

TERRAIN ANALYSIS

3-59. Division terrain-analysis support provides the commander and staff elements at the division and below with essential information used in mission analysis and COA development as well as in the preparation of annexes or appendixes to orders (see Appendix E).

3-60. The following paragraphs discuss the terrain analysis supporting the DMAIN, the TAC, and the maneuver brigades (when employed). The DMAIN's terrain-analysis element supports the division's topographic needs but focuses on meeting the analytical requirements of the division commander and his staff—mainly the G2 and the G3.

3-61. The terrain-detachment element supporting the division TAC provides technical advice and assistance to the assistant division commander-maneuver (ADC-M) and other staff officers from the TAC's engineer mobility cell. This cell establishes a working interface with the mobility cell to facilitate terrain and battle-space visualization. Using the DTSS and the All-Source Analysis System (ASAS), this cell develops and disseminates specialized topographic products through the MCS for use by DTAC representatives and the maneuver brigades. This frees the engineer mobility element to concentrate on the C^2 of engineer operations, the receipt and logging of tactical reports, and the execution of administrative actions related to the maintenance of situational awareness and the CTOE.

3-62. Terrain cells supporting the brigade provide topographic analysis for brigade commanders. The brigade engineer in the brigade's TOC rolls up all of the brigade's topographic requirements. Using this guidance, the topographic analyst reviews the GI database resident on the DTSS to facilitate development and production of mission folders and other specific topographic products to complement topographic analysis for the specific missions performed in support of deep, close, and rear operations.

3-63. Under the division commander's guidance, information received from the division staff and maneuver brigades, echelons above division (EAD), and the command-estimate process, the ADE identifies friendly- and enemy-terrain data acquired from the MCS and ASAS databases. The terrain-analysis process begins by reviewing all information resident in the topographic database to determine information requirements and data voids in support of specific requirements or tactical operations. The topographic analyst uses the DTSS to acquire this information via client-server relationships over the DMAIN's local-area network (LAN).

3-64. During the analytical process, the terrain analyst will begin compiling topographic information and terrain products to be included in mission folders to support tactical operations identified by the ADE and the assistant brigade engineer. The terrain element officer in charge (OIC)/NCOIC at the DMAIN and brigade TOCs will, as the situation dictates, provide the commanders with a verbal description of the terrain supported by graphical representations. The graphical picture (digital overlay) illustrates specific terrain considerations and the recommendations provided by the division or brigade engineer. In the event of digital failures or where units supporting tactical operations are not digitally equipped, it is recommended that the division engineer uses and disseminates paper products to offset the flow of topographic data.

3-65. The topographic analyst has a robust digital cartographic capability within the DTSS software suite. This capability is used to display GI products as required. During field operations, time constraints may limit the full use of the cartographic finishing process. Cartographic appearance may not be as critical as the accurate hasty product. Where time permits (garrison operations), digital cartography will be applied according to the local SOP.

TOPOGRAPHIC SURVEY

3-66. The requirements for topographic surveys in the division are limited based on the current and future technologies of organic positioning equipment. The division's topographic-survey requirements are collected by the division engineer (DIVEN) staff and forwarded to the corps's engineer staff where the survey assets reside. Topographic-survey requirements can be across the BOS from FA, ADA, aviation, intelligence, communications, or construction control points. The majority of topographic-survey requirements at the division are for initial-positioning validation or establishment.

TOPOGRAPHIC PRODUCTION

3-67. Topographic production includes a graphic portrayal of information (usually in cartographic and imagery formats) and hasty graphics

reproduction. The corps's topographic-production assets will augment the division's terrain detachment to support hard-copy production requirements that exceed the division's low-volume production capability. As part of the production process, the division's terrain detachment at the DMAIN consolidates production requirements and develops special terrain products for distribution to requestors using the DTSS. The DTSS enables the topographic analyst to receive, format or reformat, store, retrieve, create, update, manipulate, and distribute digital topographic data to the TAC, maneuver brigades, and other users of the information within the division.

3-68. As requests for information are received, the division or brigade engineer staff prioritizes the production effort. For example, a change in mission has caused a unit to maneuver through an area where movement is restricted. A new requirement has been created whereby the topographic analysts must now conduct a hasty topographic analysis and develop associated overlays to support this maneuver rather than continue work on a previously designated project. As a result, the division engineer realigns work priorities and reprioritizes projects. The terrain-detachment commander subsequently assigns the various topographic analysts' work priority in coordination with the appropriate engineer staff officer (the division engineer), the ADE, the plans officer, the battalion S2, and so forth.

3-69. As part of the production process, topographic analysts at all command levels prepare and develop mission folders that contain specific topographic information and terrain products relative to the command level or unit supported. These products are used to gain a better appreciation of the terrain and its use by filling information voids or defining operational impacts. As the tactical situation develops, the topographic analysts work closely with the division engineer or the brigade engineer to provide the CTOE that identifies all terrain features impacting maneuver at both the division and maneuver brigade levels. Analysts can share this folder during the production process to ensure that the information provided is complete in all respects and that the data contained in the folder has been validated before dissemination.

3-70. Web-based technologies provide a way to rapidly catalog and disseminate GI databases. For example, developing and maintaining a terrain home page that may be accessed via the division's LAN is one method that may be used for providing GI. This home page could consist of a series of folders that include relevant information related to topographic analysis and associated overlays. It could also reference information pertaining to the location of available terrain products.

3-71. The division's terrain detachment uses the master GI database to develop specific terrain products, topographic information, and decision aids, which are distributed through the primary and secondary file servers established throughout the division. The embedded mapping tool kit of the DTSS and the ABCS contains a set of software that enables terrain evaluation using a set of standardized criteria that focuses on topographic analysis and the production of terrain products. The mapping tool kit facilitates the topographic analysts' and ABCS operator's ability to evaluate the AO, develop a limited set of TDAs, and provide an accurate digital display of terrain data.

3-72. The concept of TDAs provides the means for mission-focused topographic support at the tactical level. These TDAs are used to organize terrain information and products into data sets to answer terrain-related questions, considerations, or impacts for a specific AO. With the assignment of terrain-detachment elements at the DMAIN, the DTAC, and the maneuver brigades, commanders are empowered in their ability to request and expect timely and responsive topographic support. Battle drills developed and practiced by the topographic analyst at the DMAIN, DTAC, and maneuver brigade's terrain-detachment elements facilitate the timely development of mission folders needed to support tactical operations.

Chapter 4

Battlefield Digitization

Advances in technology continue to affect how we conduct warfare. Communications connectivity, line-of-sight (LOS) limitations, map and compass navigation, hierarchical flow and bottlenecked information, and static CPs are all giving way to new technologies and procedures as we digitize the battlefield. The military is modernizing its forces through digitization. Digitization is the near-real-time transfer of battlefield information between diverse fighting elements. This transfer permits the shared awareness of the tactical situation. Digitization leverages information-age technologies to enhance the art of command and to facilitate the science of control. Continued insertion of digital (data) technology into sensors, intelligence fusion systems, communications systems, and smart munitions will increase our ability to manage, process, distribute, and display C^2 information rapidly and globally.

OVERVIEW

4-1. Microprocessing and space-based technologies have combined to permit almost real-time distribution of battlefield information. Broadband transmission systems, modular communications components, and automated decision-support systems enable high-speed data distribution to all levels of the C^2 structure. Facsimile, video, global-positioning information, and graphic overlays for digital mapping are examples that support commanders even at lower echelon units (the war-fighting entity).

4-2. This chapter describes the digital systems used by the DOD and the Army. The linkage of these systems is critical for maintaining situational awareness and common-picture displays and for providing information to the battle commander. The key components are GI, digital-map backgrounds, TDAs, and topographic-analysis products. Although these components are vertical or stovepipe development programs, it is mandatory that we integrate them horizontally.

GLOBAL COMMAND AND CONTROL SYSTEM

4-3. The Global Command and Control System (GCCS) is a predominant source for generating, receiving, sharing, and using information securely. It provides reconnaissance and surveillance (R&S) information and access to global intelligence sources as well as data on the precise location of friendly forces. The GCCS and GCCS-Tactical (GCCS-T) provide a means for crisis planning, intelligence analysis and support, tactical planning and execution, and collaborative planning.

4-4. War fighters can plan, execute, and manage military operations with the GCCS. The system helps joint-force commanders synchronize the actions of air, land, sea, space, and special-operations forces. It has the flexibility to be used in a range of operations—from actual combat to humanitarian assistance. The Joint Operational Planning and Execution System (JOPES) is responsible for maintaining and updating the nation's worldwide military plans. This system has been transferred into the digital environment.

ARMY BATTLE COMMAND SYSTEM

4-5. The ABCS will provide the framework for the digitized battlefield to become interoperable. The system is an integrated network of battlefield automated information systems, providing a seamless C^2 capability from the strategic echelon to the foxhole. It uses common hardware, a core set of common support software, and functionally unique software. The ABCS's purpose is to help commanders obtain optimal, near-real-time access to CCIR through force-level databases. Optimal means getting the right information to the right place at the right time, under all war-fighting conditions. The ABCS provides strategic, operational, and tactical C^2 for contingency operations across all spectrums of conflict. Joint Vision 2010 and Army Vision 2010 lay out the future strategic framework concepts for US forces. Both of these visions identify combined and joint activities as the reality for any future military operation. The requirement for, and means of, achieving interoperability between systems is developing rapidly. The primary systems of the ABCS include the—

- GCCS-Army (GCCS-A).
- MCS.
- ASAS.
- Combat-Service-Support Control System (CSSCS).
- Forward-Area Air-Defense System for Command and Control ($FAADC^2$).
- Advanced Field-Artillery Tactical Data System (AFATDS).
- Force XXI Battle Command—Brigade and Below ($FBCB^2$) System.

Additionally, the ABCS is supported by the—

- Army Airspace Command and Control (A^2C^2).
- DTSS.
- Integrated Meteorological System (IMETS).
- Integrated Systems Control (ISYSCON).
- War-Fighter Information Network (WIN) and the Tactical Internet (TI).

4-6. The ABCS will provide users with standard, modular systems and applications-support software coupled with a tailorable set of functional applications software (both common and functionally unique). This system and software will create, access, and update the ABCS common database (ACDB) and generate a user-defined relevant common operational picture of the battlefield in both time and space. The ABCS's current developmental programs extend from the joint/strategic command, control, computers, communications, and intelligence (C^4I) systems via the GCCS-A through the

TO to the operational/tactical headquarters. These systems will culminate in near-real-time, digital links among the tactical BOS functions at brigade and below. The WIN will be developed to satisfy communications requirements essential to the ABCS's information exchange. The WIN must support the war fighter under all conditions.

4-7. The ABCS is the integration of fielded and developmental BOSs and communications used in both training and tactical environments, in developed and undeveloped theaters, and in fixed installations and mobile facilities. The ABCS is interoperable with standard DOD C^4I systems, architectures, and protocols. The objective is to network the strategic, operational, and tactical headquarters and to interoperate with theater, joint, and combined C^2 systems across the full range of BOS functions. The ABCS will use automated source data entry wherever possible to populate the ACDB. This is tailorable to support information requirements, planning, and the use of decision-support tools by commanders to meet METT-TC requirements.

GLOBAL COMMAND AND CONTROL SYSTEM-ARMY

4-8. The GCCS-A is the Army's link between the ABCS and the GCCS. The GCCS-A will provide a set of modular applications and information and decision support to Army strategic planning, operations, and sustainment. The GCCS-A will support the apportionment, allocation, logistical support, and deployment of Army forces to the combat commands. The system will be used for force tracking; host-nation and civil-affairs support; theater air defense; targeting; psychological operations; C^2; and logistics, medical, and personnel statuses. The GCCS-A will be deployed from theater EAC elements to corps.

MANEUVER CONTROL SYSTEM

4-9. The MCS is the primary battle-command source. It provides the common operational picture, decision aids, and overlay capabilities to support the tactical commander through interface with the force-level information database populated from the other BOSs. The MCS provides the common applications necessary to access and manipulate the information database. It will satisfy information requirements for a specific operation; effect timely control of current combat operations (deep, close, and rear); and develop and distribute plans, orders, and estimates effectively in support of future operations. It will also support the decision-making process. The MCS will be deployed from corps to the maneuver battalions.

ALL-SOURCE ANALYSIS SYSTEM

4-10. The ASAS is the intelligence and electronic warfare (IEW) component from EAC to the battalion. It is a mobile, tactically deployable, computer-assisted IEW processing system. The ASAS receives and rapidly processes large volumes of combat information and sensor reports from all sources to provide timely and accurate targeting information, intelligence products, and threat alerts. It consists of evolutionary modules that perform system-operations management, system security, collection management, intelligence processing and reporting, high-value/high-payoff target processing and nominations, and communications processing and interfacing.

The ASAS—Remote Workstation (ASAS-RWS) provides automated support to the G2/S2's doctrinal functions from EAC through battalion, including special-operations forces (SOF). It also operates as the technical-control portion of the ABCS's intelligence node to provide current IEW and enemy situation (ENSIT) information to the intelligence database for access and use by the ABCS's users. The ASAS produces the ENSIT portion of the battlefield's common operational picture disseminated by the ABCS network.

COMBAT-SERVICE-SUPPORT CONTROL SYSTEM

4-11. The CSSCS provides critical, timely, integrated, and accurate automated CSS information to CSS, maneuver, and theater commanders and logistics and special staffs. Critical resource data is drawn from manual resources and from the Standard Army Management Information System (STAMIS) at each echelon (STAMIS will evolve to the Integrated Combat-Service-Support System [ICS^3]). The CSSCS processes, analyzes, and integrates resource information to support the evaluation of current and projected force-sustainment capabilities. It will be deployed from EAC to brigade level.

FORWARD-AREA AIR-DEFENSE SYSTEM FOR COMMAND AND CONTROL

4-12. The $FAADC^2$ system integrates air-defense (AD) fire units, sensors, and C^2 centers into a coherent system capable of defeating or denying the aerial threat (UAVs, helicopters, fixed-wing aircraft, and so forth). It provides the automated interface (corps and below) for the AD control segments to the ABCS and allows commanders to communicate, plan, coordinate, direct, and control the counterair fight. The system provides rapid collection, storage, processing, display, and dissemination of critical, time-sensitive situational awareness (air and ground) and battle-command information throughout the forward-area AD battalion and between other AD, Army, joint, and combined elements. The $FAADC^2$ provides the third-dimension situational-awareness component of the ACDB. The air- and missile-defense workstation (AMDWS) will provide elements from EAC to battalion with the capability to track the air- and missile-defense battle.

ADVANCED FIELD-ARTILLERY TACTICAL DATA SYSTEM

4-13. The AFATDS provides automated decision support for the FS functional subsystem, to include joint and combined fire (such as naval gunfire and close air support). The AFATDS provides a fully integrated FS C^2 system, giving the FS coordinator (FSCOORD) automated support for planning, coordinating, controlling, and executing close support, counterfire, interdiction, and AD suppression fires. The AFATDS performs all of the FS operational functions, including automated allocation and distribution of fires based on target-value analysis. The AFATDS will be deployed from EAC to the firing batteries and will provide the FS overlay information to the ACDB.

FORCE XXI BATTLE COMMAND—BRIGADE AND BELOW

4-14. The $FBCB^2$ is a set of digitally interoperable applications and platform hardware. It provides on-the-move, real-time, and near-real-time situational awareness and C^2 information to combat, combat support (CS), and CSS

leaders from brigade to the platform and soldier levels. The FBCB^2 will populate the ACDB with automated positional friendly information and current tactical battlefield geometry for friendly and known or suspected enemy forces. The goal is to field the FBCB^2 to the tank and the Bradley fighting vehicle and other platforms with a common look-and-feel screen. Common hardware and software design will facilitate training and SOPs.

ARMY AIRSPACE COMMAND AND CONTROL

4-15. The A^{2}C^2 system is an aircraft-based C^2 system that provides the maneuver commander with an airborne C^2 capability. The system includes voice and data equipment for battlefield information processing and connectivity equivalent to the ground tactical CP and the battle-command vehicle (BCV). This enables the war fighter to exercise C^2 of assigned and attached elements and to coordinate with adjacent, supported, and supporting forces. Specifically, the A^{2}C^2 system provides a relevant common picture of the battlefield and provides the necessary C^{4}I links to keep this common picture updated and completely interoperable with other C^2 vehicles (such as the BCV and the command and control vehicle (C^{2}V). This system incorporates components of the common operating environment. During operations other than war, the system will provide connectivity to embassy, law-enforcement, maritime, civil, and other humanitarian information and communications networks.

DIGITAL TOPOGRAPHIC SUPPORT SYSTEM

4-16. The DTSS is the topographic-engineer and topographic-analysis component that provides critical, timely, accurate, and analyzed digital and hard-copy mapping products to the battle commander for terrain visualization. The DTSS is an integral part of the force-level information database. It supports commanders from theater (via the GCCS-A) to brigade (via the MCS or FBCB^2) levels by preparing tailored map products and TDAs. The DTSS will also generate tailored data sets for war-fighting entities based on data sets prepared by NIMA, intelligence resources, and imagery-collection assets. Tailored data sets and TDAs are created using the GIS and imagery-analysis software. Units will deploy with a foundation data set and MSDS based on missions and contingency areas. Map updates and enriched data sets will be disseminated using satellite and tactical communications means. The DTSS will manage all digital topographic data at the echelon at which it is employed.

INTEGRATED METEOROLOGICAL SYSTEM

4-17. The IMETS is the meteorological component of the IEW subelement of the ABCS. The IMETS provides commanders at all echelons with an automated weather system to receive, process, and disseminate weather observations, forecasts, and weather and environmental effects decision aids to all BOSs. The IMETS and staff weather teams are assigned to echelons from brigade through EAC and to Army SOF. They receive weather information from polar-orbiting civilian and defense meteorological satellites, the Air Force Global Weather Center, artillery meteorological teams, remote sensors, and civilian forecast centers. The IMETS processes and collates

forecasts, observations, and climatological data to produce timely and accurate weather products tailored to the specific war fighter's needs. The most significant weather and environmental support to war fighters is the automated TDAs produced by the IMETS. These graphics go beyond briefing the weather by displaying the impact of the weather on current, projected, or hypothesized conditions on both friendly and enemy capabilities. Instead of reacting to the weather, the war fighter can use it to his advantage.

INTEGRATED SYSTEMS CONTROL

4-18. The ISYSCON provides automated management and synchronization of multiple tactical communications and C^2 systems. Theater, EAC, and division signal units will use the ISYSCON. It will provide automated assistance for the following signal operations:

- Network planning and engineering.
- Battlefield-spectrum management (BSM).
- Wide-area network (WAN) management.
- Communications-security (COMSEC) management.
- C^2 of signal units.

TACTICAL INTERNET

4-19. The TI, a subcomponent of the WIN, will enhance war-fighter operations by providing an improved, integrated data communication network for mobile users. The TI passes C^4I information, extending tactical automation C^4I systems to the soldier/weapons platform. The TI will focus on brigade and below to provide the parameters in defining a tactical automated data communications network.

COMBAT TERRAIN INFORMATION SYSTEMS

4-20. Essential to the ABCS's operational concept and relevant common picture are single-entry, near-real-time information and automated interaction between each BOS. This interaction should be such that data entered at any node in the architecture is distributed to all other nodes requiring that data without copying or re-entering the information. The elapsed time will be consistent with the needs of the operational mission. The ABCS will allow users with different security classifications to use a single communications backbone.

4-21. It is important to achieve interoperability between the ABCS and the CTIS, with the CTIS being the component for topographic data. This is the capability of people, organizations, and equipment to operate effectively together and share information so that it can be used across domains. Geospatial interoperability is hindered by information extracted to varying definitions, attribution rules, reference geometry, resolution, content, and currentness. It is also hindered by finishing and dissemination processes that apply varying formats and inconsistent data boundaries and tiling schemes. User systems may reformat information, apply inconsistent symbology, or run analytic and visualization packages based on different assumptions or rules. It is both impossible and undesirable to root out all differences because GI

supports so many specialized applications. Compatibility must be achieved across essential interfaces (BOSs) through common data models and exchange standards.

4-22. The CTIS will provide four systems with the automation tools to support the Army's operational and tactical terrain-visualization missions. These systems will allow topographic analysts to manipulate and manage digital terrain data to produce accurate, tailored, digital terrain-visualization products and to produce multicolor hard-copy map products. The CTIS allows the fusion of information from different domains and provides an integrated view of the mission space. The DTSS is currently being fielded as a replacement for the Legacy Systems (see Appendix F).

- The DTSS-B supports theater operations with imagery interpretation and generation of data obtained from national resources. Products generated are disseminated to forward-deployed C^2 and topographic engineer assets.
- The DTSS-D (see Figure 4-1) supports all topographic engineer units by providing sophisticated imagery-analysis and GIS topographic-analysis tools. This transit-case system is tailorable to the mission and command deployment requirements.
- The DTSS-H (see Figure 4-1) is a tactical system mounted on 5-ton trucks with a 20-foot international standards organization (ISO) shelter. The system is located at corps and heavy division CPs and has full topographic-analysis functionality and rapid digital-map-generation capability.

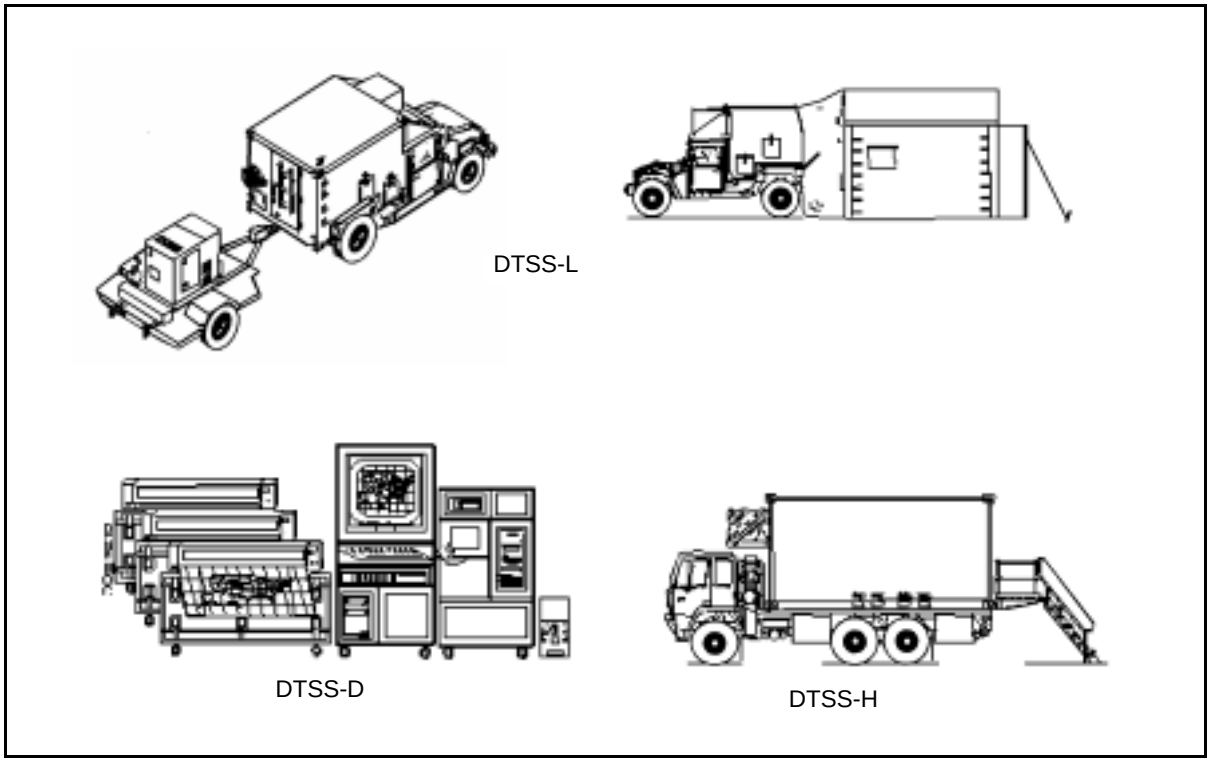


Figure 4-1. DTSS

- The DTSS-L (see Figure 4-1, page 4-7) is mounted on high-mobility, multipurpose wheeled vehicles (HMMWVs) supporting JTF to maneuver-brigade-force operations. The DTSS-L develops and manages products tailored and focused for the supported unit's mission

4-23. Future requirements will require digital access to databases and the ability to enrich and exploit GI. Topographic-engineer responsibilities include identifying, submitting, and prioritizing requirements and managing and disseminating information and updates.

TOPOGRAPHIC SURVEY

4-24. Surveying has become a digital science. The modern survey systems work with software specifically designed to process field data, perform computations, and produce a precise product (whether it is a global positioning system [GPS] network, a digital database, or a computer-aided design [CAD]). Survey computations require a computer system to process large amounts of mathematics variables. The effort should be ongoing to obtain or upgrade to the fastest systems available. Computer resources are standardized on the tables of organization and equipment (TOE) for units with topographic surveyors. Application and functional software packages increase the topographic surveyor's efficiency and productivity. The survey information center (SIC) collects and disseminates the positioning and orientation requirements of NIMA; FA, ADA, and armor units; and the USAF. The SIC maintains a digital database capable of archiving, querying, and manipulating survey control. The topographic surveyor is equipped with common GPS hardware and software, CAD software (Terramodel and Autocad), and survey-applications software.

GLOBAL POSITIONING SYSTEM—SURVEY

4-25. The Navigation Satellite Timing and Ranging (NAVSTAR) GPS is capable of determining accurate positional, velocity, and timing information. The Precise Positioning Service (PPS) consists of military users and authorized representatives. The PPS user can obtain high instantaneous positioning if the receiver is capable of accepting the necessary cryptologic variables. When two or more receivers are used, it is called differential GPS (DGPS) surveying. The error values are determined and removed from the survey either by postprocessing or real-time processing of the data. The type of DGPS survey method used depends on accuracy requirements. There are two basic types of DGPS surveys—the static and dynamic surveys. The static survey uses a stationary network of receivers, collecting simultaneous observations over a predetermined time interval. This type of survey yields the best accuracy. The dynamic survey uses one stationary receiver and any number of remote or roving receivers. It allows for rapid movement and collection of data over a large area. When operating in real-time mode, the roving receiver can place very accurate positions instantaneously, as the mission requires, on the battlefield.

AUTOMATED INTEGRATED SURVEY INSTRUMENT

4-26. The automated integrated survey instrument (AISI) provides the topographic surveyor with the improved capability to extend control in a more timely and efficient manner. It is a total station, combining angular, distance, and vertical measurements into a single electronic instrument. The AISI is designed to digitally record and transfer data into a computer.

Appendix A

Metric Conversion Chart

This appendix complies with current Army directives that state that the metric system will be incorporated into all new publications. Table A-1 is a conversion chart.

Table A-1. Metric Conversion Chart

Metric to English			English to Metric		
Multiply	**By**	**To Obtain**	**Multiply**	**By**	**To Obtain**
Length					
Centimeters	0.0394	Inches	Inches	2.54	Centimeters
Meters	3.28	Feet	Feet	0.0305	Meters
Meters	1.094	Yards	Yards	0.9144	Meters
Kilometers	0.621	Miles (stat)	Miles (stat)	1.5609	Kilometers
Kilometers	0.540	Miles (naut)	Miles (naut)	1.853	Kilometers
Millimeters	0.039	Inches	Inches	25.40	Millimeters
Area					
Square centimeters	0.1550	Square inches	Square inches	6.45	Square centimeters
Square meters	10.76	Square feet	Square feet	0.0929	Square meters
Square meters	1.196	Square yards	Square yards	0.836	Square meters
Volume					
Cubic centimeters	0.610	Cubic inches	Cubic inches	16.39	Cubic centimeters
Cubic meters	35.3	Cubic feet	Cubic feet	0.0283	Cubic meters
Cubic meters	1.308	Cubic yards	Cubic yards	0.765	Cubic meters
Milliliters	0.0338	US liq ounces	US liq ounces	29.6	Milliliters
Liters	1.057	US liq quarts	US liq quarts	0.946	Liters
Liters	0.264	US liq gallons	US liq gallons	3.79	Liters
Weight					
Grams	0.0353	Ounces	Ounces	28.4	Grams
Kilograms	2.20	Pounds	Pounds	0.454	Kilograms
Metric tons	1.102	Short tons	Short tons	0.907	Metric tons
Metric tons	0.984	Long tons	Long tons	1.016	Metric tons

Appendix B

Standard and Nonstandard Topographic Products

The topographic community has dramatically increased its ability to provide timely, accurate map backgrounds and decision aids to assist the commander at all echelons to visualize the terrain. Digital methods of topographic analysis, cartography, printing, and surveying have revolutionized the methods of presenting essential elements of terrain information. Combined with the ability to transmit GI rapidly around the world, this will assist the engineer in establishing the CTOE for the war fighter.

OVERVIEW

B-1. This appendix is intended to provide a graphical reference for the war fighter. It is divided into three main sections—standard topographic products and services provided by NIMA, nonstandard topographic products and TDAs produced by the topographic unit, and terrain-evaluation aids produced by the individual consumers. All of these processes depend on a common database of GI. The use of GI data ranges from product viewing and terrain evaluation to complex terrain analyses. The DTSS is the primary tool used to prepare complex products or TDAs. This support can be found at theater, corps, and division. Several suites of government and commercial software will provide the individual consumer with the tools to view and evaluate the terrain.

STANDARD TOPOGRAPHIC PRODUCTS AND SERVICES

B-2. Standard NIMA-produced maps, graphics, and digital GI are available through normal supply channels. This includes, but is not limited, to standard stock-numbered items such as—

- Hard-copy products, including—
  - Topographic line maps (TLMs) — 1:25,000; 1:50,000; and 1:100,000.
  - City graphics — 1:12,500 to 1:5,000.
  - Joint operational graphics (JOGs) — 1:250,000.
  - Tactical pilot charts (TPCs) — 1:500,000.
  - Operational navigation charts (ONCs) — 1:1 million.
  - Jet navigation charts (JNCs) — 1:3 million.
  - Global navigation charts (GNCs) — 1:5 million.
  - Other small-scale, large-area planning charts — 1:10 million to 1:40 million.
  - Topographic publications and services (handbooks and text files, catalogs, and services).
  - Planning terrain-analysis database (PTADB).

  - Targeting support information (hard-copy charts, targeting data, digital models, and catalogs).
  - Imagery-analysis information (reports and tailored products).
  - International Hydrographic Organization (IHO) chart series.
  - Hydrographic publications and services (handbooks, services, and catalogs).
  - Aeronautical publication services (catalogs and handbooks).
  - Flight-information publications (FLIPs).
- Digital and soft-copy GI, including—
  - Arc digitized raster graphics (ADRGs) — TLMs, city graphics, JOGs, ONCs, TPCs, JNCs, and GNCs.
  - Compressed ADRG (CADRG) — TLMs, city graphics, JOGs, ONCs, TPCs, JNCs, and GNCs.
  - Controlled-image base (CIB) panchromatic, 10-, 5-, and 1-meter resolution imagery.
  - City-image graphics.
  - Digital terrain-elevation data (DTED) — levels 1 through 5.
  - Fire-finder elevation data (FFED) — based on DTED level 1.
  - Vector map — levels 0, 1, 2, and urban.
  - Interim terrain data (ITD) — 1:50,000.
  - Vector interim terrain data (VITD) — 1:250,000.
  - Digital feature-analysis data (DFAD) — levels 1 and 1C.
  - Foundation feature data (FFD) — 1:250,000 varies to 1:100,000.
  - MSDS — variable large scales (supplements FFD).
  - Compressed aeronautical chart (CAC).
  - Digital point position database (DPPDB) — classified SECRET.

NONSTANDARD TOPOGRAPHIC PRODUCTS

B-3. Nonstandard topographic products are produced from multiple sources and can be printed on film (when available) or paper. They can also be transmitted digitally via signal assets in several file formats. These products are used as TDAs or map substitutes.

B-4. A TDA is any product that assists the commander in visualizing the terrain. It is an enhanced representation of existing terrain and weather data used to highlight impacts to military operations. TDA models include, but are not limited to the following models. The paragraphs that follow are examples of TDAs produced by these models.

- Mobility.
- Terrain elevation.
- Special-purpose product builders (SPPBs).
- Intervisibility.
- Tactical dam (TACDAM) analysis.
- IMETS.
- Environmental and climatology.

MOBILITY

B-5. The mobility model provides speed predictions for movement on road, off road, and across rivers and streams under specific weather conditions. It is also used to determine the major reasons (primary vehicle, terrain, or weather influences) that cause either restricted mobility or speed reductions for vehicles or foot marches. The mobility model uses—

- The North Atlantic Treaty Organization [NATO] Reference Mobility Model II (NRMMII).
- The Waterways Experiment Station (WES) algorithm integrated with the Arc Info and Grid GIS.
- Regional attribute translation tables.
- DMA feature file (DMAFF) ITD attributes (limited area coverage).
- Historical weather inputs and IMETS weather data.

B-6. The following are examples of TDAs produced by the mobility model:

- On-road speed. Depicts the on-road speed for a user-specified vehicle using the NRMMII as determined from weather data, soil conditions, and the transportation network. See Figure B-1, page B-11.
- Off-road speed. Depicts the off-road speed for a user-specified vehicle using the NRMMII as determined from weather data, soil conditions, vegetation, slope, and obstacles. See Figure B-2, page B-12.
- On-road reason. Depicts the on-road speed and the limiting factors for a particular on-road speed product. See Figure B-3, page B-13.
- Off-road reason. Depicts the off-road speed and the limiting factors for a particular off-road speed product. See Figure B-4, page B-14.
- On-road comparison. Depicts the on-road areas where one vehicle has a speed advantage over another vehicle, taking into account the on-road speed predictions for each vehicle. See Figure B-5, page B-15.
- Off-road comparison. Depicts the off-road areas where one vehicle has a speed advantage over another vehicle, taking into account the off-road speed predictions for each vehicle. See Figure B-6, page B-16.
- Trafficability. Depicts the number of passes a user-specified vehicle can cross the terrain before it becomes severely restricted. See Figure B-7, page B-17.
- Surface degradation. Depicts the rut depth created by a vehicle for a user-specified number of passes with a user-specified vehicle. See Figure B-8, page B-18.
- Gap crossing. Depicts the ford, span, and swim capability for a user-specified vehicle. See Figure B-9, page B-19.
- Gap-crossing reason. Depicts the reasons why conditions exist for a particular gap-crossing product. See Figure B-10, page B-20.
- On-road route. Depicts the optimum on-road route between two or more user-specified points by analyzing an existing on-road speed product. See Figure B-11, page B-21.
- Overland route. Depicts the best overland route between two or more user-specified points by analyzing an input shaded-time-distance product. The start point for the overland-route product must be the

same point used to generate the shaded-time-distance product. See Figure B-12, page B-22.

- Mobility corridors. Depicts the maximum size corridors around restricted areas using an off-road speed product together with troop size. See Figure B-13, page B-23.
- Shaded-time distance. Depicts the time required for a user-specified vehicle to travel from a user-specified location to all other locations in the AOI. This product is generated from existing on-road and off-road speed products. See Figure B-14, page B-24.

TERRAIN ELEVATION

B-7. The terrain-elevation model produces products based on DTED. These products will provide the battlefield commander with a quick view of the terrain based on relief and slope. Elevation products are useful for determining air avenues of approach (AAs), signal transmission and reception sites, key terrain, and mobility (based on slope).

B-8. The following are examples of TDAs produced by the terrain-elevation model:

- Contours. Depicts a contour map at user-defined intervals from elevation data. See Figure B-15, page B-25.
- Contour tint. Depicts contours color coded to user-defined intervals. Intervals can be constant or variable. See Figure B-16, page B-26.
- Elevation tint. Depicts a polygonal banded elevation product at user-defined intervals. Intervals can be constant or variable. See Figure B-17, page B-27.
- Slope. Depicts polygonal groupings of user-defined slope ranges in percent. See Figure B-18, page B-28.
- Slope aspect. Depicts the prevailing direction of slope (for example, north facing or east facing). See Figure B-19, page B-29.

SPECIAL-PURPOSE PRODUCT BUILDER

B-9. The SPPB model provides the capability to produce, combine, and query attributes of existing products. This enables the creation of user-defined output products such as concealment, bivouac sites, construction resources, drop zones, and landing zones. The SPPB model—

- Uses user-defined queries from vector data or existing products.
- Uses ITD, VITD, DFAD, and FFD.
- Has the ability to store, edit, and share frequently used queries.
- Incorporates proximity analysis or size criteria.

B-10. The following are examples of TDAs produced by the SPPB model:

- Data query. Data query allows the user to create tailored products by querying the feature attribute database.
- Helicopter landing zone. These zones are created by querying the ITD database for relatively flat slope areas, sparse vegetation, and well-drained soils. See Figure B-20, page B-30.

- Smart Stacker. Smart Stacker performs Boolean queries between existing product categories to create new product categories. Unlike Product Stacker, which results in everything in all input products, Smart Stacker results in a product that meets the query criteria from each input product. Input can be any polygonal mobility, terrain-elevation, intervisibility, or SPPB product. The displayed product depicts acceptable helicopter landing zones in masked areas. The helicopter landing-zone product created in data query and the masked-area plot product created with the intervisibility functions was inputted to creat this product. See Figure B-21, page B-31.

INTERVISIBILITY

B-11. The intervisibility models graphically display information based on terrain elevation (including feature height [vegetation]) if it is selected and available. The models are used to depict areas where observers and targets would be visible to each other or hidden from view. The intervisibility model—

- Uses digital elevation data as input.
- Can include feature height information.
- Uses user-specified sites or flight paths.
- Uses user-specified target locations or altitudes.
- Uses optical or electronic LOS.

B-12. The following are examples of TDAs produced by the intervisibility model:

- Masked-area plot. Depicts areas around a site in which a target (at a user-specified altitude) is shielded from that site. See Figure B-22, page B-32.
- Target acquisition. Depicts the points at which incoming targets (at user-specified altitudes) first become visible to a user-specified site. Product description includes refractivity parameters, angular radial increments, and the minimum detection zone. See Figure B-23, page B-33.
- Flight-line masking. Depicts the areas of the terrain that are masked from the view of an aircraft following a user-specified flight path when the line of view is perpendicular to the flight line. See Figure B-24, page B-34.
- Flight-line target locator. Calculates the minimum altitude necessary for an aircraft to keep a specific target in view. See Figure B-25, page B-35.
- Obstructed-signal loss. Depicts radio-frequency signal loss around a user-specified site as a function of distance from the site and atmospheric conditions as well as effects of the terrain. See Figure B-26, page B-36.
- Unobstructed-signal loss. Depicts radio-frequency signal loss around a user-specified site as a function of distance from the site and atmospheric conditions. This model does not take into consideration the effects of terrain on the signal loss. See Figure B-27, page B-37.

TACTICAL DAM ANALYSIS

B-13. The TACDAM model predicts dam breaching and reservoir overflow results based on DTED, vector coverage, and other user-defined parameters. The TACDAM model has the following characteristics:

- Digital elevation data is used as input.
- Vector drainage coverage can be used to locate dams, reservoirs, and downstream points.
- Two major analysis modules are used—dam break and reservoir outflow.
- Reservoir outflow requires additional spillway-gate parameters.

B-14. The following are examples of TDAs produced by the TACDAM model:

- Dam break, flood zone. Depicts a polygonal product that represents the extent of the flooded area when a dam has been damaged. See Figure B-28, page B-38.
- Dam break, depth contour. Depicts a polygonal product that represents the depth of the water (in meters) within the flooded area when a dam has been damaged. See Figure B-29, page B-39.
- Dam break, velocity contour. Depicts a polygonal product that represents the water velocities (in kilometers per hour [kph]) within the flooded area when a dam has been damaged. See Figure B-30, page B-40.
- Reservoir outflow, flood zone. Depicts a polygonal product that represents the extent of the flooded area when a reservoir has been damaged.
- Reservoir outflow, depth contour. Depicts a polygonal product that represents the depth of the water (in meters) within the flooded area when a reservoir has been damaged.
- Reservoir outflow, velocity contour. Depicts a polygonal product that represents the water velocities (in kph) within the flooded area when a reservoir has been damaged.

INTEGRATED METEOROLOGICAL SYSTEM

B-15. IMETS data is converted into polygonal vector coverages that are used as stand-alone products or interactive data needed to predict mobility and intervisibility. The IMETS models has the following characteristics:

- The model uses meteorological data obtained from an IMETS server.
- Data sets consist of numeric values that represent observed and forecasted meteorological conditions.
- TDAs are produced by grouping numeric values into polygonal classes.

B-16. The following are examples of TDAs produced by the IMETS model:

- Surface pressure. Depicts a polygonal product representing surface pressure (in millibars). See Figure B-31, page B-41.
- Surface-wind direction. Depicts a polygonal product representing surface-wind direction. Wind direction is provided in degrees (with 0 being north) and increasing in a clockwise direction. The direction

provided is always the direction the wind is blowing. See Figure B-32, page B-42.

- Soil temperature. Depicts a polygonal product representing soil temperature (in degrees Celsius). See Figure B-33, page B-43.
- Visibility. Depicts a polygonal product representing visibility (in kilometers). See Figure B-34, page B-44.
- Ambient air temperature. Depicts a polygonal product representing ambient air temperature (in degrees Celsius).
- Dew point. Depicts a polygonal product representing dew point (in degrees Celsius).
- Snow depth. Depicts a polygonal product representing snow depth (in millimeters).
- Rain rate. Depicts a polygonal product representing rain rate (in millimeters per hour).
- Accumulated precipitation. Depicts a polygonal product representing accumulated precipitation (in millimeters).

ENVIRONMENTAL AND CLIMATOLOGY

B-17. The environmental and climatology models provide planning tools to determine the effects on material and personnel; sunrise and sunset; moonrise, moonset, and illumination; helicopter load predictions; and historical climatology. The following are examples of TDAs produced by the environmental and climatology models:

- Environmental thresholds and impacts (ETIs). The user can query information that contains quantitative and qualitative statements regarding the effects of the environment on material, personnel, or operations.
- Sunrise, sunset, and twilight. Predicts sunrise, sunset, and twilight times for user-specified dates and locations.
- Moonrise, moonset, and illumination. Predicts moonrise and moonset times and moon illumination percentage for user-specified dates and locations.
- Climatology databases. The user can query historical databases such as historical climatic statistics, density altitude climatology, surface-wind climatology, and paradrop climatology collected from stations across the world.
- Helicopter load determination. The user can query the maximum load-carrying capabilities of different helicopters for different temperatures and altitudes.

TERRAIN-EVALUATION TOOLS

B-18. Terrain evaluation does not include such in-depth studies as cross-country mobility, which requires the analysis of climatology and current weather conditions, soil conditions, and enemy and friendly vehicle performance metrics. However, terrain evaluation does include the tangible aspects of slope, relief, distance, accessibility, features, map and image display, and three-dimensional (3-D) viewing. Various government off-the-

shelf (GOTS) and COTS software applications can be used as terrain-evaluation tools. The following are examples of subtasks provided within the terrain-evaluation tool kit:

DIGITAL DATA VIEWER

B-19. Terrain-evaluation tools provide the ability to view maps, imagery, feature data, and elevation data in numerous digital file formats (see Figure B-35, page B-45). This allows the user to focus on a specific area for evaluation.

LINE OF SITE

B-20. The LOS creates a profile view of the terrain from the observer's location to a target. The green lines show what the observer can see; the red lines show what he cannot see (dead space). The LOS can also display the Fresnel zones of different radio frequencies. See Figure B-36, page B-46.

Weapons Fans

B-21. Weapons fans are extremely useful and versatile tools for all BOSs to identify enemy and friendly battle positions, template obstacle locations, determine ambush sites, and so forth. Weapons fans can be drawn on elevation data, imagery, and digital maps. See Figure B-37, page B-47.

Slope Map

B-22. A slope map shades the elevation file into assigned or user-specified slope categories. Figure B-38, page B-48 shows a trafficability slope map with the four basic colors that represent the slope restrictions of the NRMMII—unrestricted, 0 to 30 percent; restricted 30 to 45 percent; and severely restricted, over 45 percent. This is especially handy for the IPB process.

TERRAIN CATEGORY

B-23. The terrain category allows you to highlight a specific combination of slope, relief, and elevation values using the elevation file. Figure B-39, page B-49 shows all areas of a 500-meter radius with a slope of 0 to 2 percent. This application is especially helpful in locating base-camp sites; landing zones and drop zones; artillery cant; petroleum, oil, and lubricants (POL) and water sites; and so forth.

PERSPECTIVE VIEW

B-24. Perspective view creates a 3-D view from a chosen position. You can select the observer's elevation, width of view, and range. This is especially helpful in checking battle positions, AAs, and terrain association. You can also drape the actual elevation colors, imagery, and maps on top. See Figures B-40 and B-41, pages B-50 and B-51.

OBLIQUE VIEW

B-25. An oblique view creates a 3-D view of the terrain from an aerial point of view. It is especially helpful in terrain visualization in areas with significant

relief. Obliques can also be used to view battle positions, AAs, mobility corridors, and engagement-area development. You can drape imagery, maps, or overlays as obliques. See Figure B-42, page B-51.

FLYTHROUGH

B-26. A flythrough allows you to fly across the terrain in a 3-D view, whether viewed with the elevation data, over imagery, or on a map. This tool will create a series of perspective views along your selected flight path, which are played in rapid succession. The flythrough has many options and can be saved as an animated graphics interchange format (GIF), video, or movie file for viewing outside of the terrain-evaluations tool.

PANORAMA

B-27. A panorama view allows you to view the terrain 360 degrees around you, whether on the ground or in the air. Like a flythrough, it can be viewed with the elevation data, over imagery, or on a map. This tool will create a series of perspective views at selected angle increments, which are played in rapid succession going clockwise or counterclockwise. The panorama view has many options and can be saved as video and movie files for viewing outside of the terrain-evaluation tools.

GPS WAYPOINTS AND TRACKS

B-28. GPS waypoints and tracks can be downloaded from the military precise lightweight GPS receiver (PLGR). The waypoints or track can be displayed in the terrain-evaluation tool. Additionally, the track can be used to create a flythrough. Waypoints can also be created in the terrain-evaluation tool and uploaded to a military GPS receiver. The user can then navigate solely by GPS. The latter technique can be used to upload a route into all of the GPS receivers for a unit making a night move. Live GPS tracking capability provides real-time bearing and speed data.

DISTANCE MEASUREMENTS

B-29. The terrain-evaluation tool has a simple distance-measuring routine with which to calculate the length of single or multileg routes in kilometers. For multileg routes, it will keep track of both individual leg lengths and the cumulative route length. The terrain-evaluation tool can also calculate the slope and bearing of each leg as well.

COORDINATE CONVERSION

B-30. The terrain-evaluation tool provides imbedded datum transformation and coordinate conversions. It also has the ability to display primary and secondary datums in one display.

ELEVATION MERGE

B-31. Another important capability of the terrain-evaluation tool is to merge multiple elevation files into one file (all operations seem to fall on the edge of two or more files). You can then permanently subset a small elevation slice out of the large file to cover your AO. See Figure B-43, page B-52.

ELEVATION OR SLOPE MERGE WITH MAPS OR IMAGERY

B-32. This terrain-evaluation tool gives the user an opportunity to visualize the relief while maintaining a common map or image background. See Figures B-44 and B-45, pages B-53 and B-54.

SUMMARY

B-33. The tools provided to the topographic community as well as the tools provided to the individual customer allow the user to view, value add, manipulate, and print digitized maps and imagery. See Figures B-46 through B-48, pages B-55 through B-57.

B-34. The integration of standard NIMA GI with data collected through other methods (qualified data) will provide a means to thoroughly visualize the terrain. The DTSS has the capability to combine layers of geographic information with TDAs and qualified data to produce a customer-defined terrain analysis or terrain depiction of the battle space. The terrain-evaluation tools provide a similar capability; however, they are limited by the amount and type of data they can consume, process, and analyze.

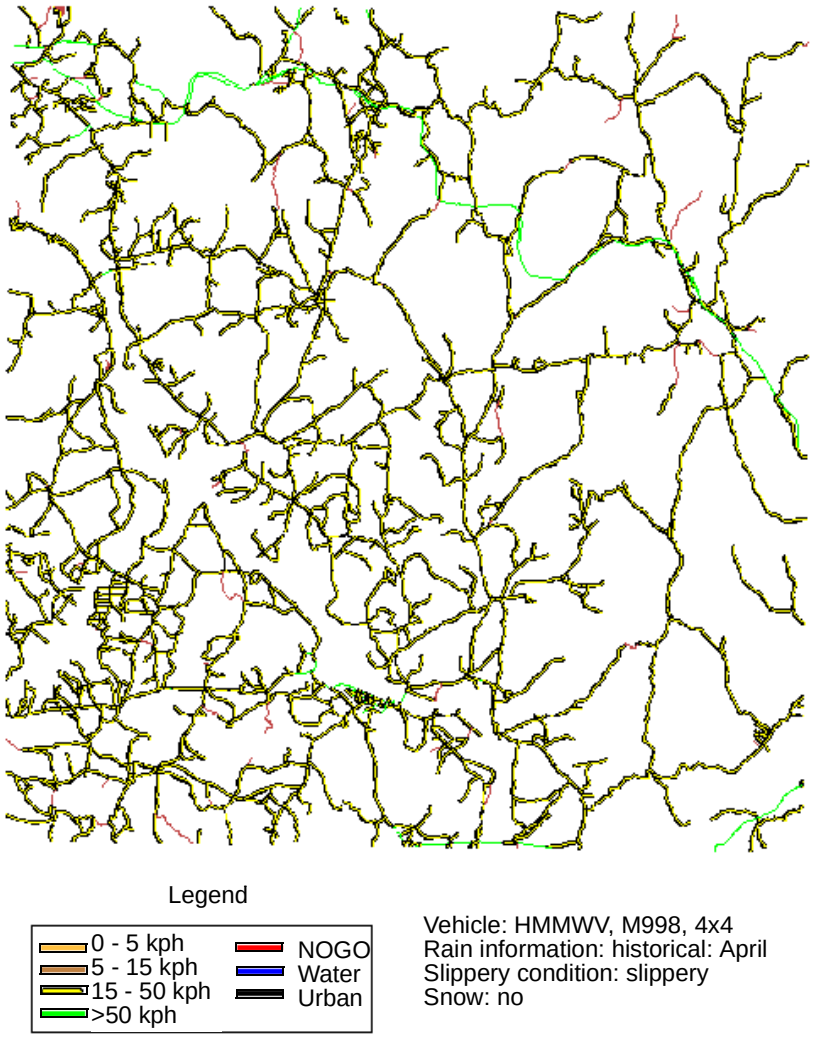


Figure B-1. On-Road Speed

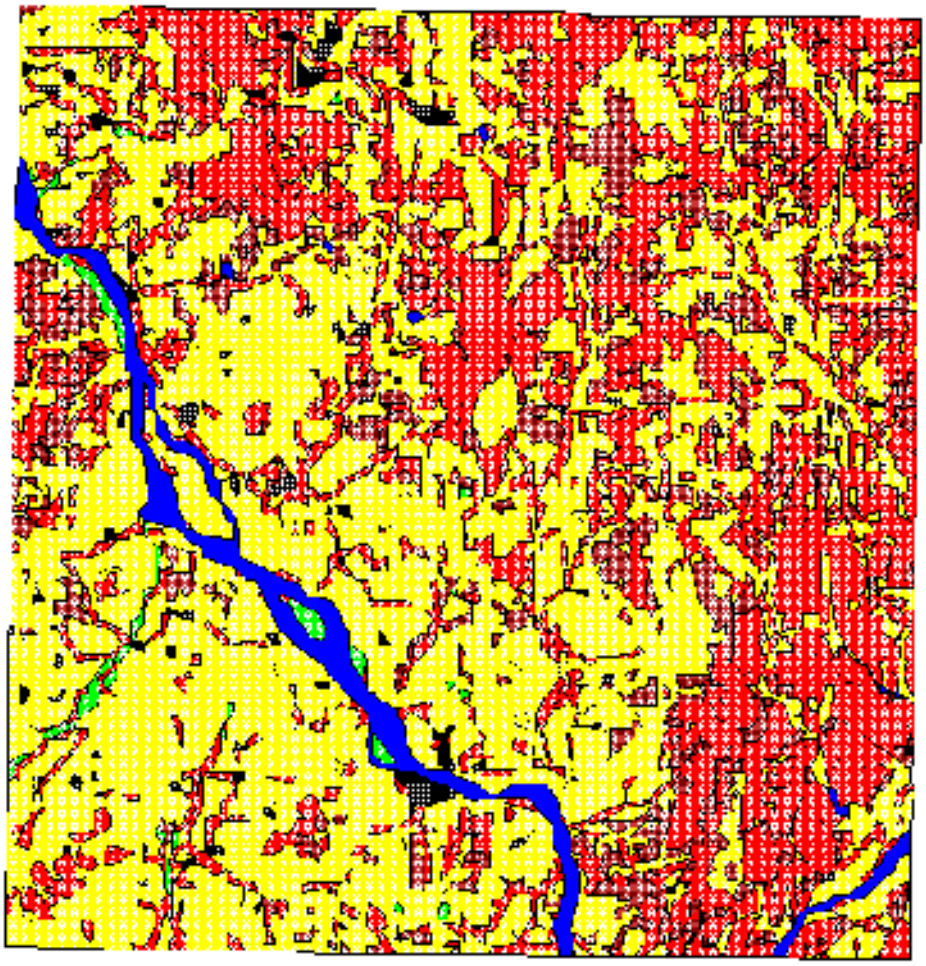
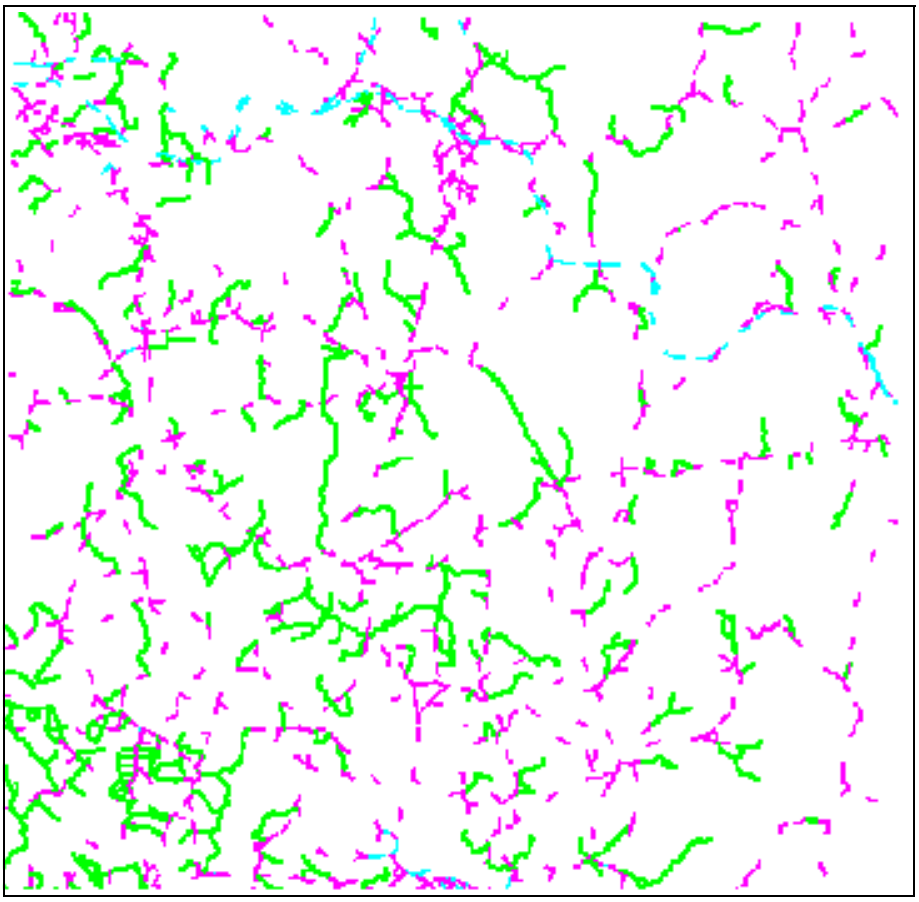


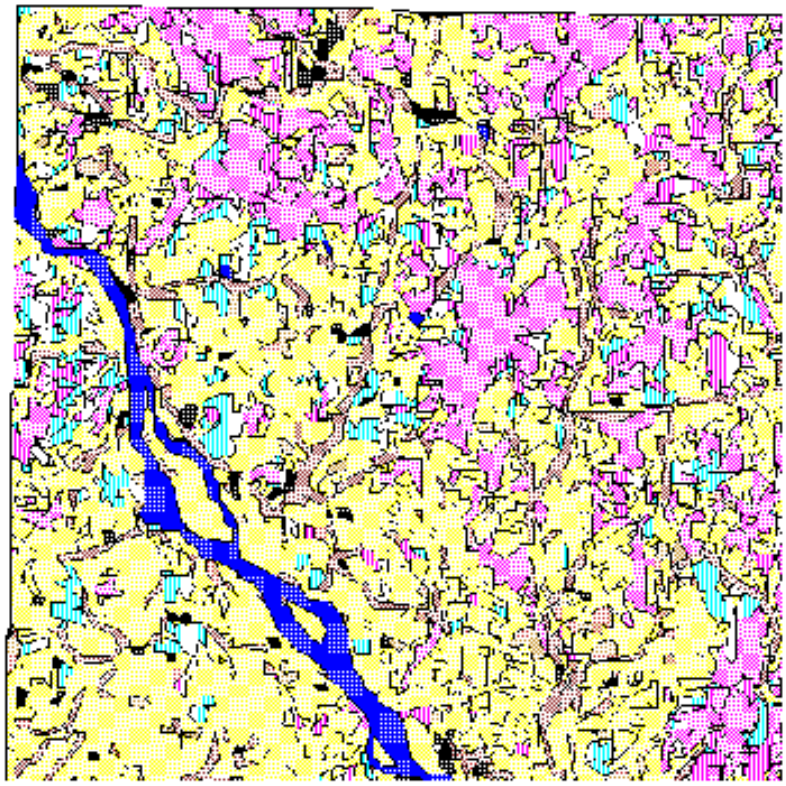
Figure B-2. Off-Road Speed



Legend

- Water
- Urban
- Unknown NOGO
- Soil NOGO on level (VCI)
- Soil and slope resistance NOGO
- Inability to brake (Vis NOGO)
- Ride dynamics limit
- Tire speed limit
- Soil, slope, and veg resistance
- Visibility
- External limit
- AASHTO curvature
- Sliding on curves
- Tipping on curves
- Unknown cause

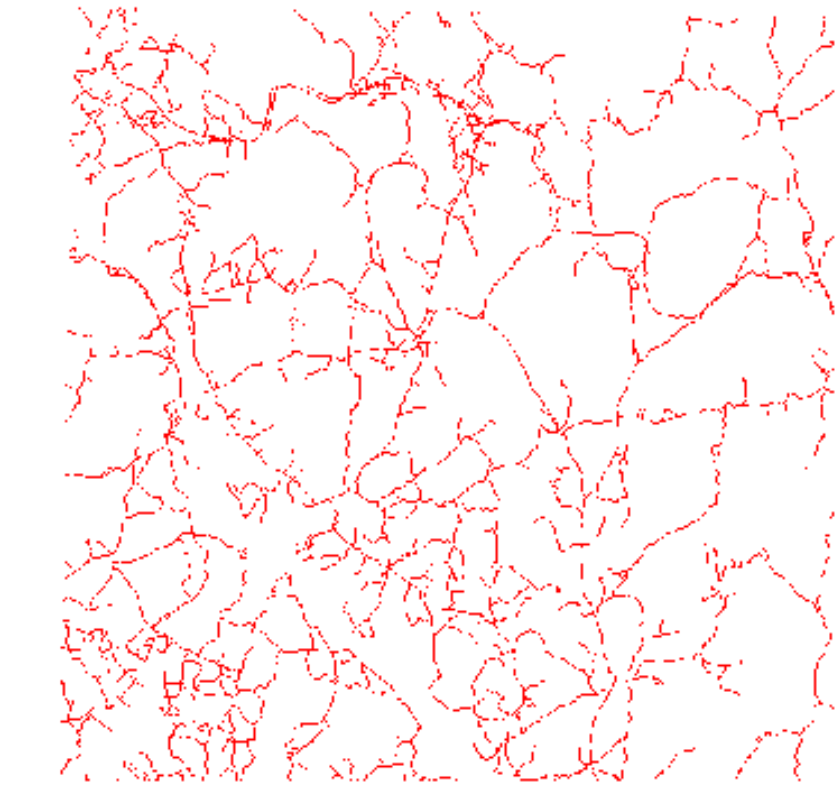
Figure B-3. On-Road Reason



Legend

Water	Ride dynamics limit
Urban	Tire speed limit
Unknown NOGO	Soil, slope, and veg resistance
Soil NOGO on level (VCI)	Visibility
Obstacle override NOGO	Maneuver around obs and veg
Vegetation override NOGO	Maneuver around veg (over obs)
Soil and slope resistance NOGO	Obstacle impact speed
Inability to brake (Vis NOGO)	Obstacle override force
Obstacle belly interference	Driver prudence overriding veg
Obstacle clearance interference	Unknown cause

Figure B-4. Off-Road Reason

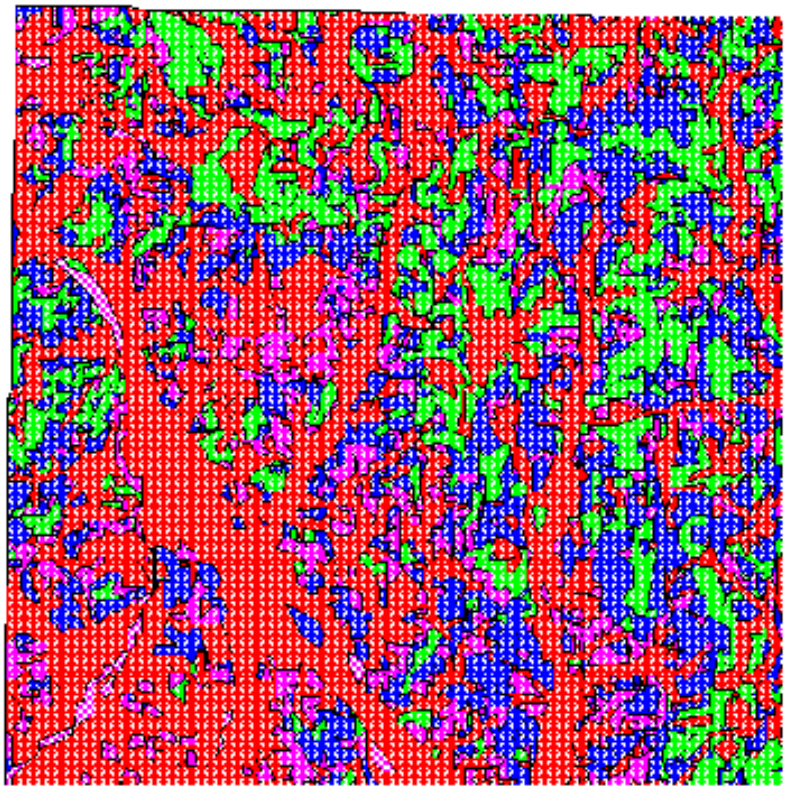


Legend

- V2 100+ percent > V1 speed
- V2 50 - 100 percent > V1 speed
- V2 25 - 50 percent > V1 speed
- Same speed + 25 percent
- V1 25 - 50 percent > V2 speed
- V1 50 - 100 percent > V2 speed
- V1 100+ percent > V2 speed

Vehicle 1 (V1): HMMWV, M998, 4x4
Vehicle 2 (V2): M1A1 Abrams tank
Rain information: historical: April
Slippery condition: slippery
Surface condition: wet
Snow: no

Figure B-5. On-Road Speed Comparison (HMMWV Versus M1A1 Tank)

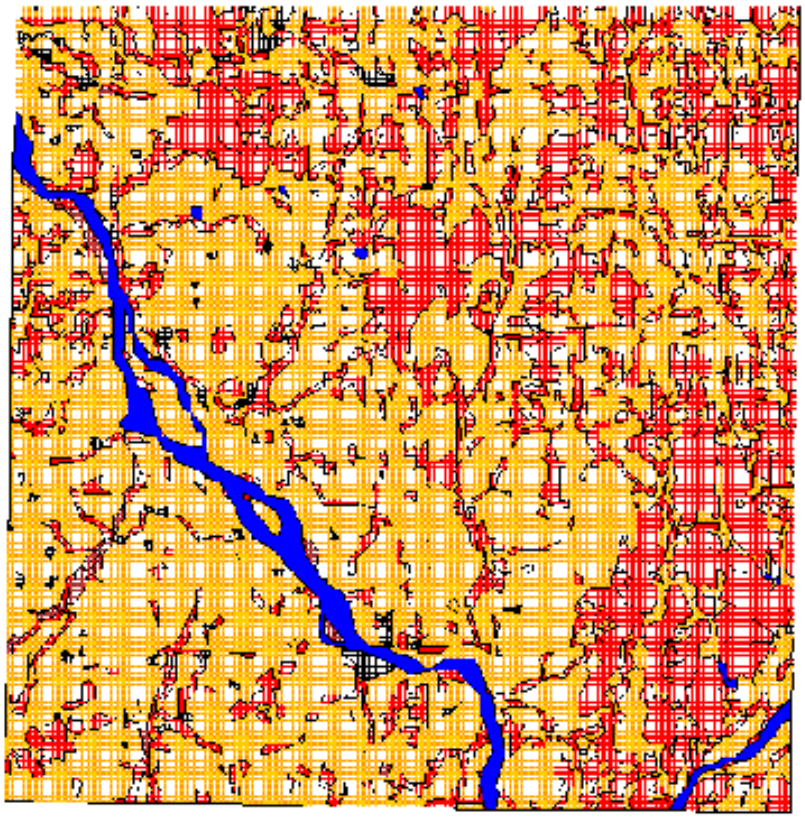


Legend

- V2 100+ percent > V1 speed
- V2 50 - 100 percent > V1 speed
- V2 2 - 50 percent > V1 speed
- Same speed + 25 percent
- V1 25 - 50 percent > V2 speed
- V1 50 - 100 percent > V2 speed
- V1 100+ percent > V2 speed

Vehicle 1 (V1): HMMWV, M998, 4x4
Vehicle 2 (V2): M1A1 Abrams tank
Rain information: historical: April
Slippery condition: slippery
Surface condition: wet
Snow: no

Figure B-6. Off-Road Speed Comparison (HMMWV Versus M1A1 Tank)

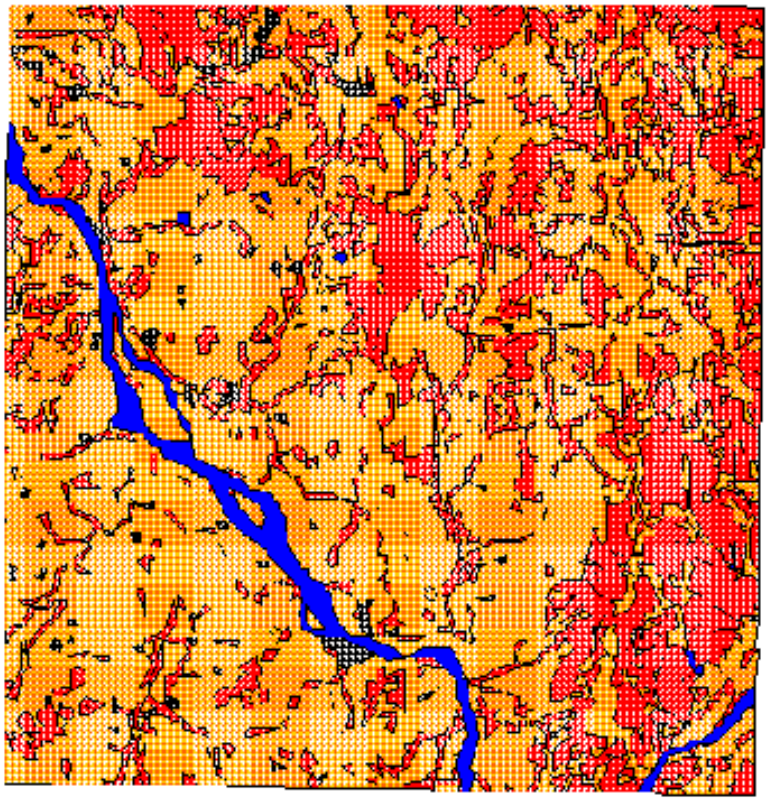


Legend

- Water
- Urban
- NOGO speed
- 0 - 5 passes
- 5 - 50 passes
- 50 - 500 passes
- 500 - 5,000 passes
- >5,000 passes

Vehicle: HMMWV, M998, 4x4
Rain information: historical: April
Slippery condition: slippery
Surface condition: wet
Snow: no

Figure B-7. Trafficability

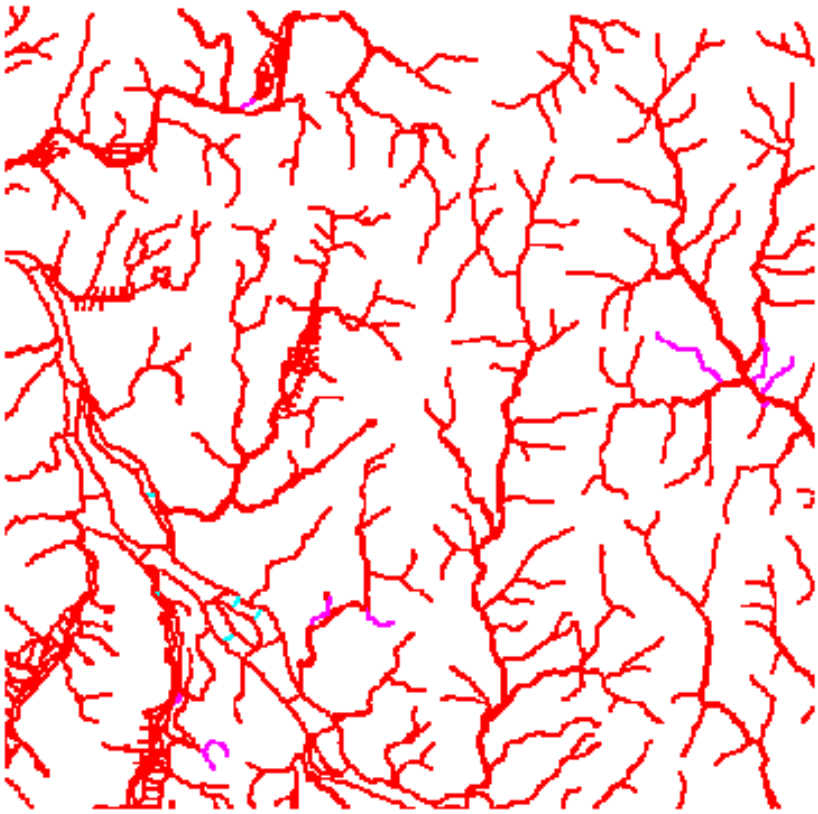


Legend

- Water
- Urban
- NOGO speed
- 0 - 4 cm minimal
- 4 - 12 cm moderate
- 12 - 100 cm severe

Vehicle: HMMWV, M998, 4x4
Rain information: historical: April
Slippery condition: slippery
Surface condition: wet
Snow: no
Number of passes: 100

Figure B-8. Surface Degradation



Legend

- NOGO
- Span
- Ford
- Swim

Vehicle: HMMWV, M998, 4x4
Rain information: historical: April
Slippery condition: slippery
Surface condition: wet
Snow: no

Figure B-9. Gap Crossing

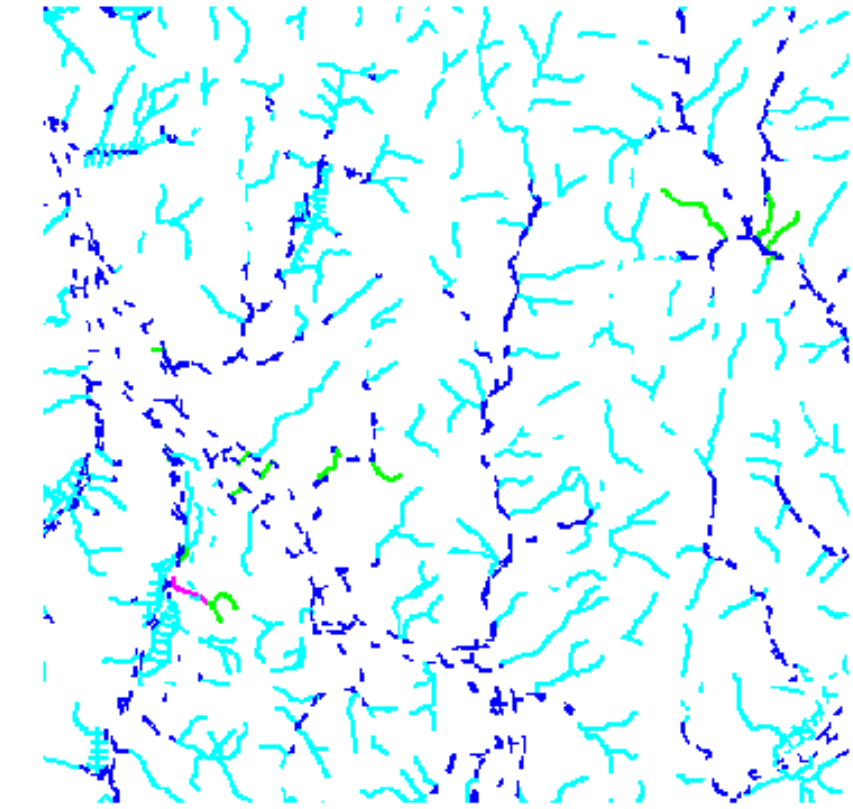
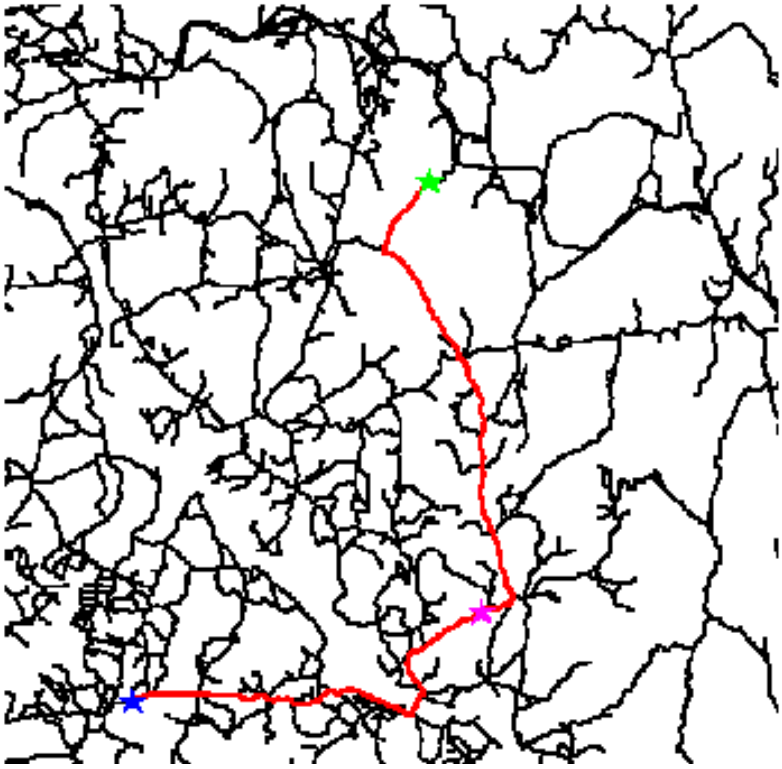


Figure B-10. Gap-Crossing Reason

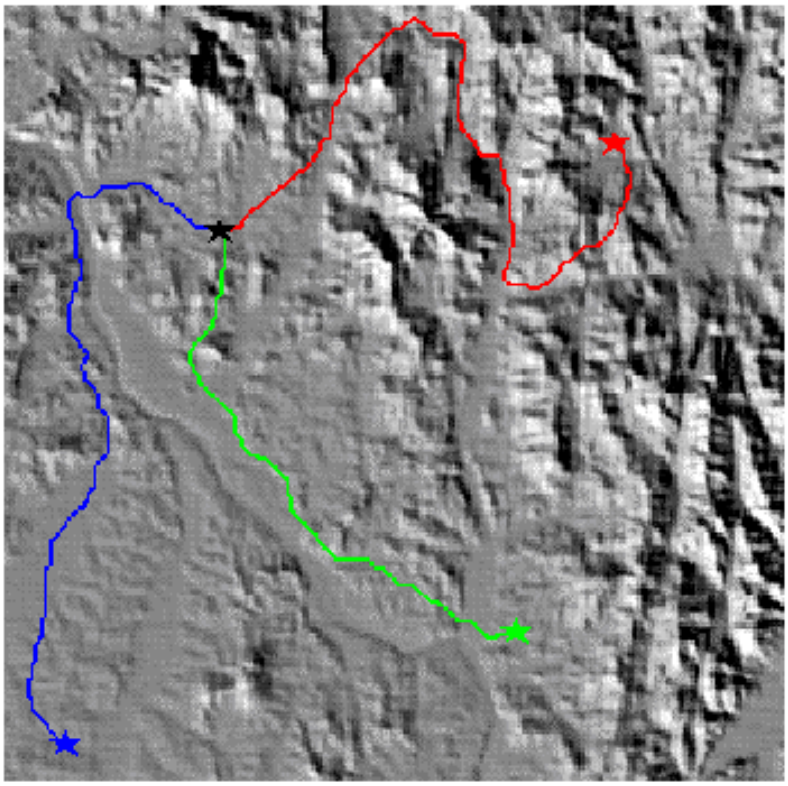


Legend

Start point
Stop 1
Stop 2
Road network
Optimum route

Vehicle: HMMWV, M998, 4x4
Rain information: historical: January
Slippery condition: normal
Surface condition: dry
Snow: no

Figure B-11. On-Road Route



Legend

Start point
End point 1 — Route 1
End point 2 — Route 2
End point 3 — Route 3

Vehicle: HMMWV, M998, 4x4
Rain information: historical: April
Slippery condition: slippery
Surface condition: wet
Snow: no

Figure B-12. Overland Route (Shaded-Relief Background)

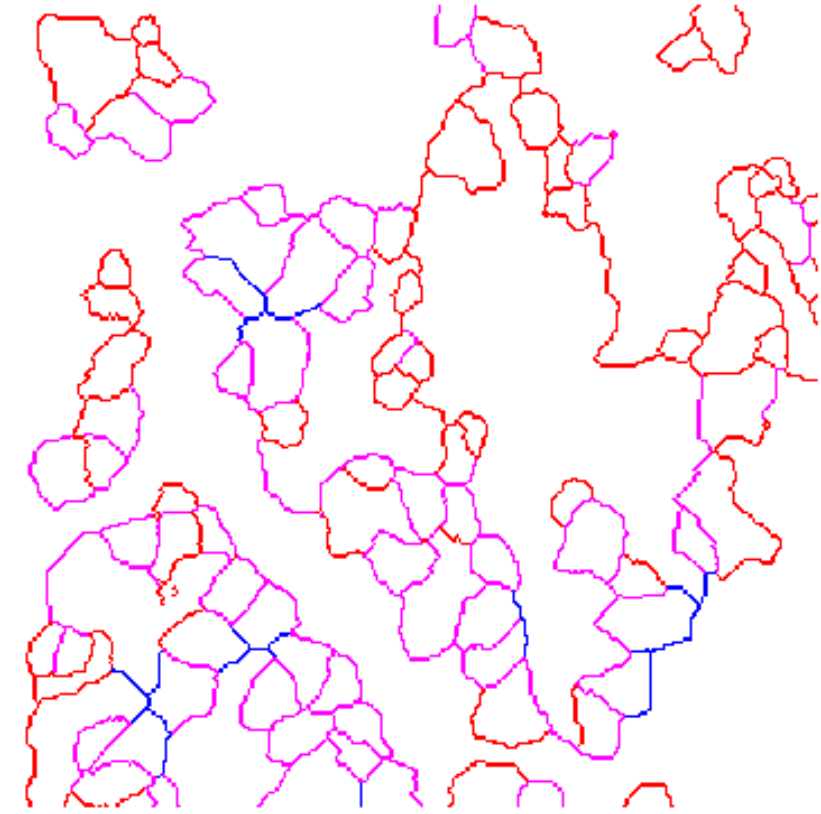


Figure B-13. Mobility Corridors

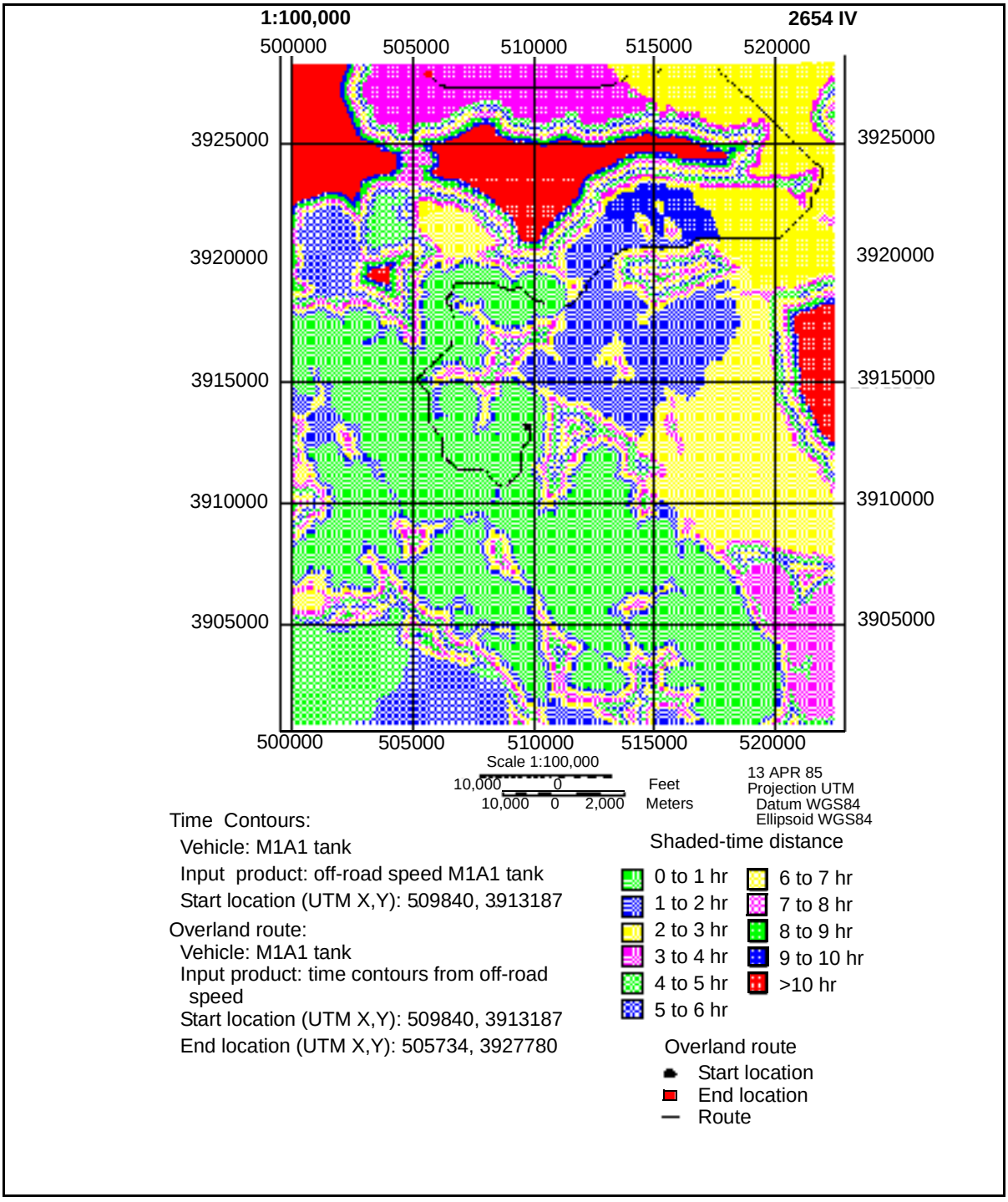
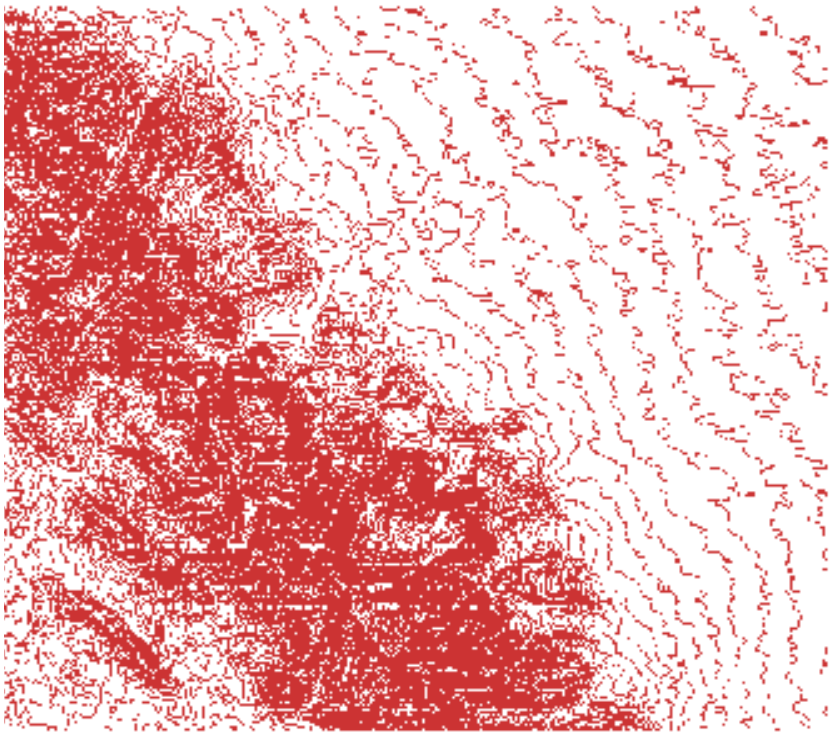


Figure B-14. Shaded-Time Distance With Overland Route

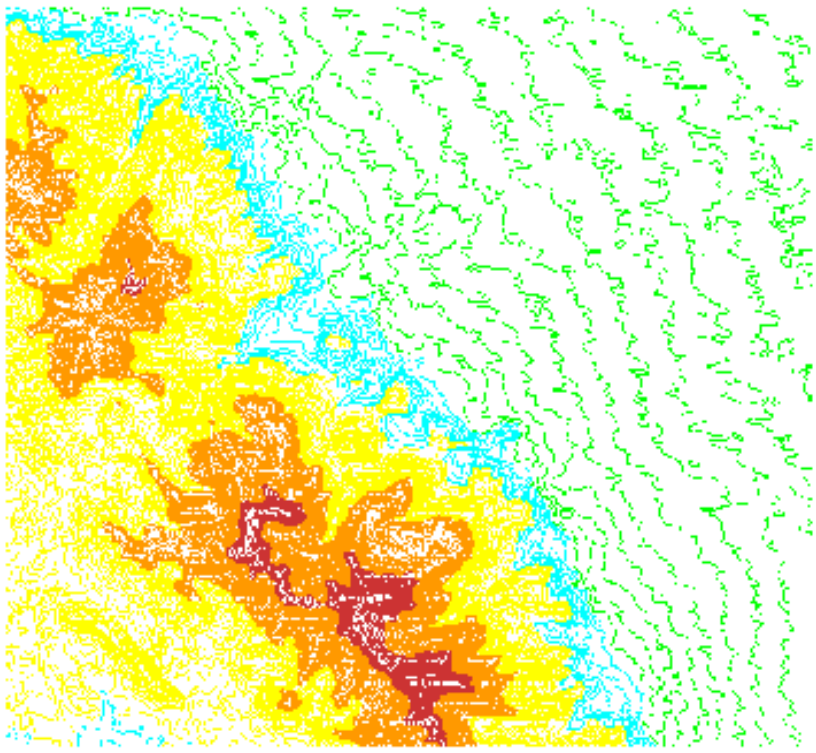


Legend

Contour

Contour Interval (m): 20
Data source:
Elevation spacing (m): 93
Elevation range:
Minimum (m): 1,262
Maximum (m): 2,862

Figure B-15. Contours



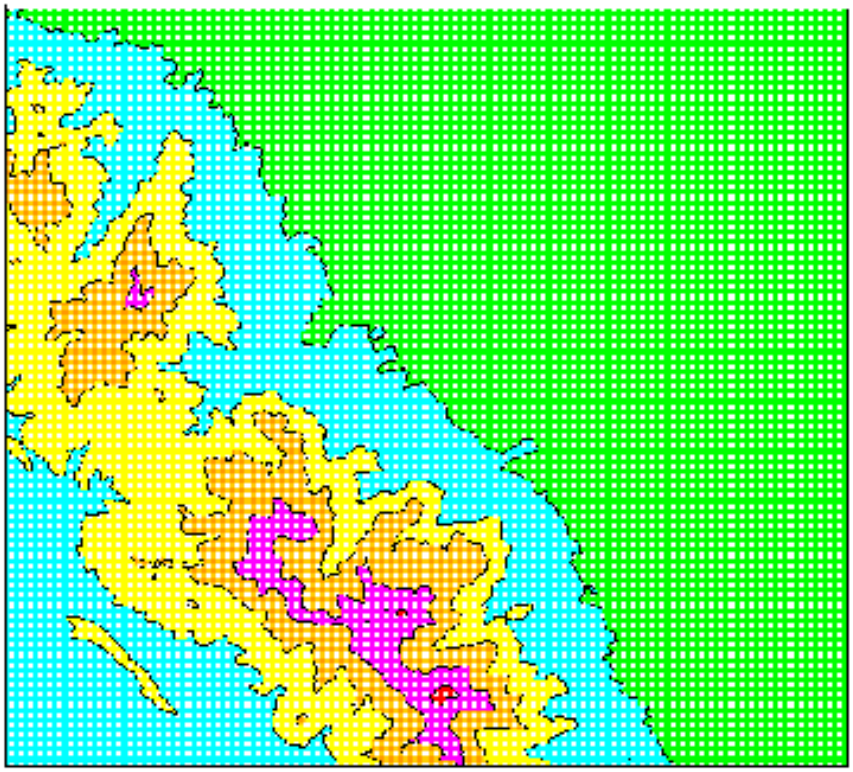
Legend

1,262 - 1,500 m
>1,600 - 1,600 m
>1,600 - 2,000 m
>2,000 - 2,500 m
>2,500 - 2,862 m

Contour Interval (m): 20
Interval type: variable
Elevation range: 1 (m): 250
2 (m): 100
3 (m): 400
4 (m): 500
5 (m): 400

Data source:
Elevation spacing (m): 93
Elevation range:
Minimum (m): 1,262
Maximum (m): 2,862

Figure B-16. Contour Tint

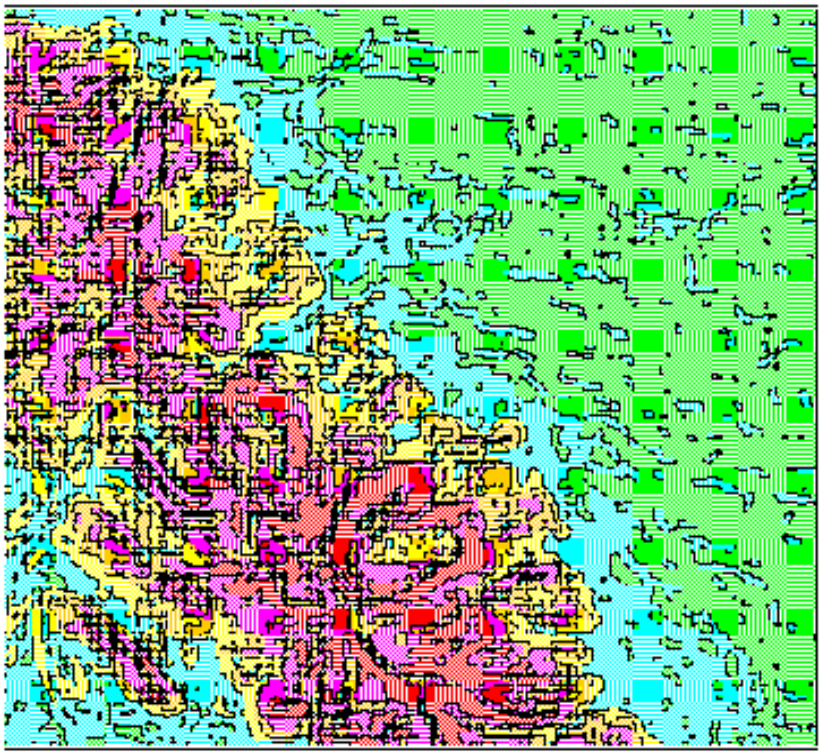


Legend

1,262 -1,500 m
>1,500 - 1,800 m
>1,800 - 2,100 m
>2,100 - 2,400 m
>2,400 - 2,700 m
>2,700 - 2,862 m

Tint interval (m): 300
Interval type: constant
Data source:
Elevation spacing (m): 93
Elevation range:
Minimum (m): 1,262
Maximum (m): 2,862

Figure B-17. Elevation Tint

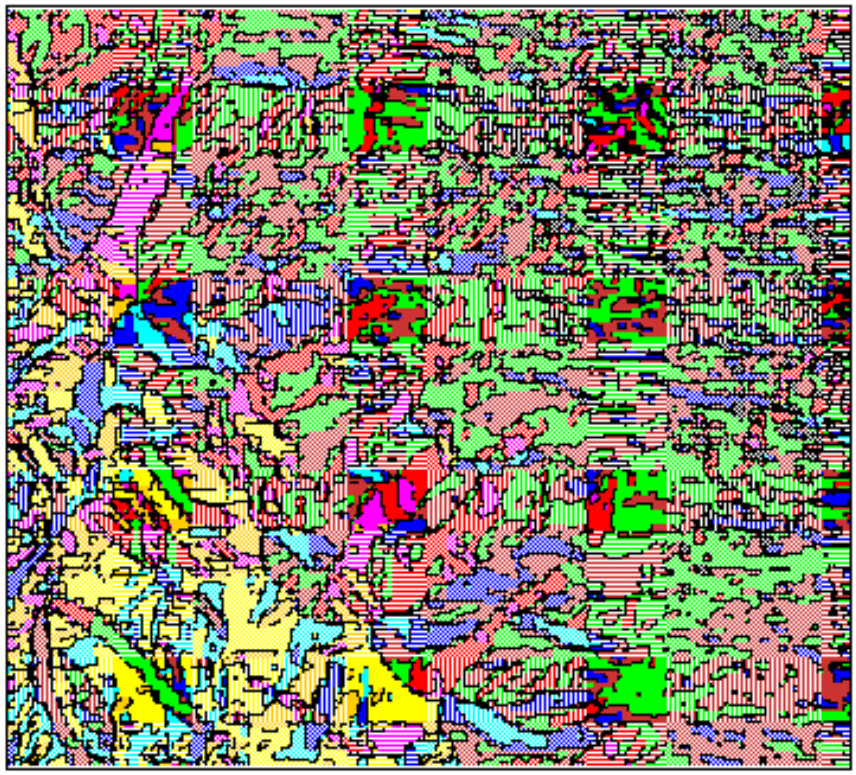


Legend

- 0 - 3 percent
- >3 - 10 percent
- >10 - 20 percent
- >20 - 30 percent
- >30 - 45 percent
- >45 percent

Data source:
Elevation spacing (m): 93
Elevation range:
Minimum (m): 1,262
Maximum (m): 2,862

Figure B-18. Slope



Legend

- N (deg): 337.5 - 22.5
- NE (deg): 22.5 - 67.5
- E (deg): 67.5 - 112.5
- SE (deg): 112.5 - 157.5
- S (deg): 157.5 - 202.5
- SW (deg): 202.5 - 247.5
- W (deg): 247.5 - 292.5
- NW (deg): 292.5 - 337.5
- Flat ground

Data source:
Elevation spacing (m): 93
Elevation range:
Minimum (m): 1,262
Maximum (m): 2,862

Figure B-19. Slope Aspect

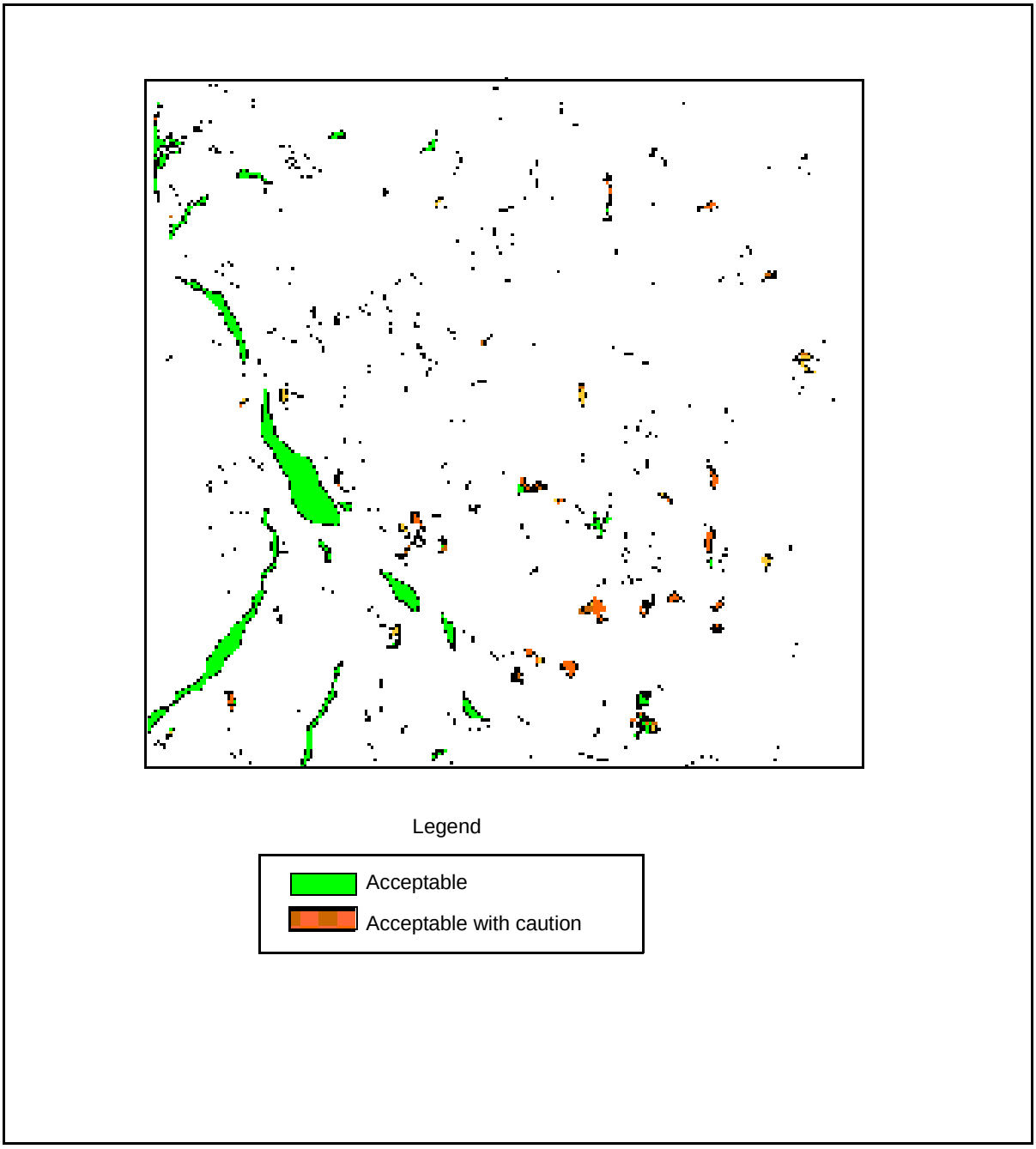


Figure B-20. Helicopter Landing Zones

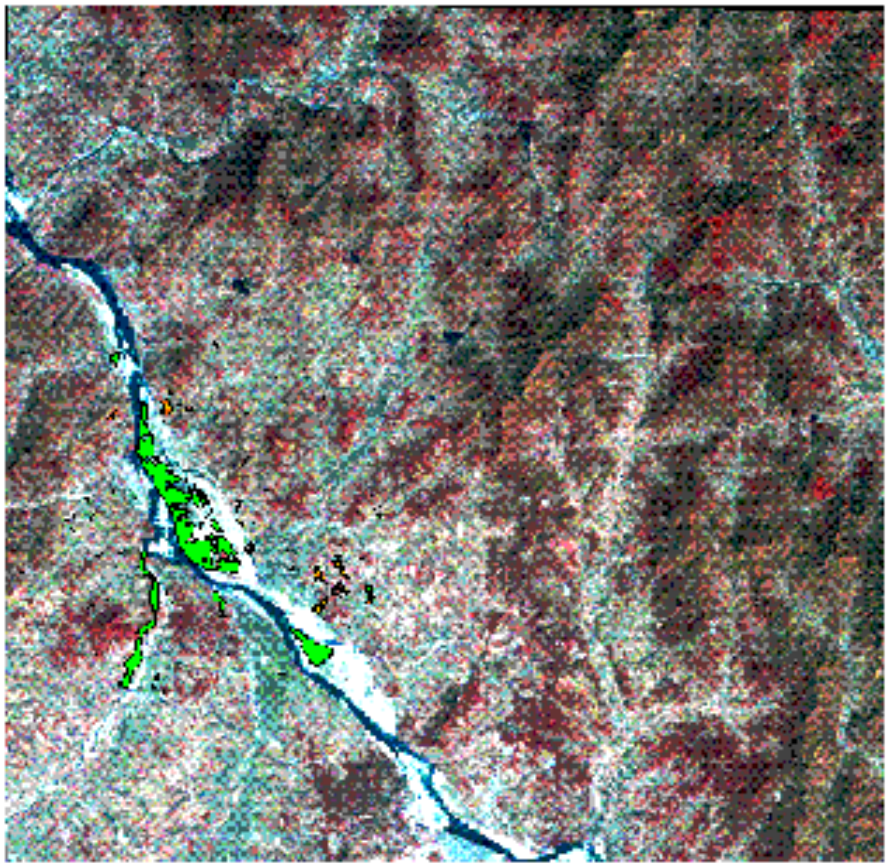
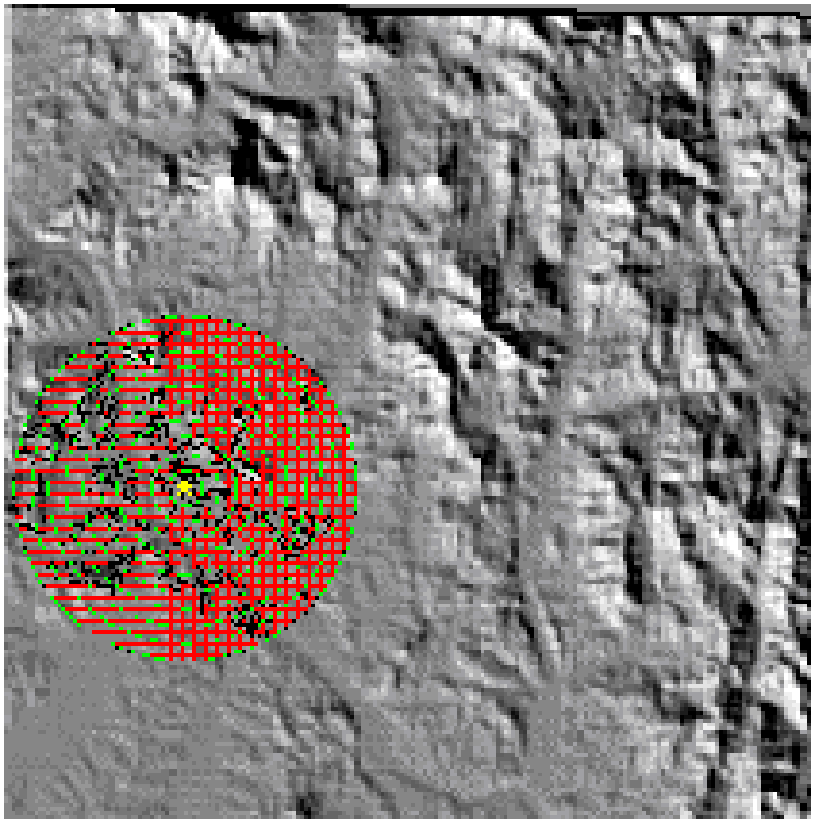


Figure B-21. Helicopter Landing Zones in Masked Areas (LANDSAT Background)



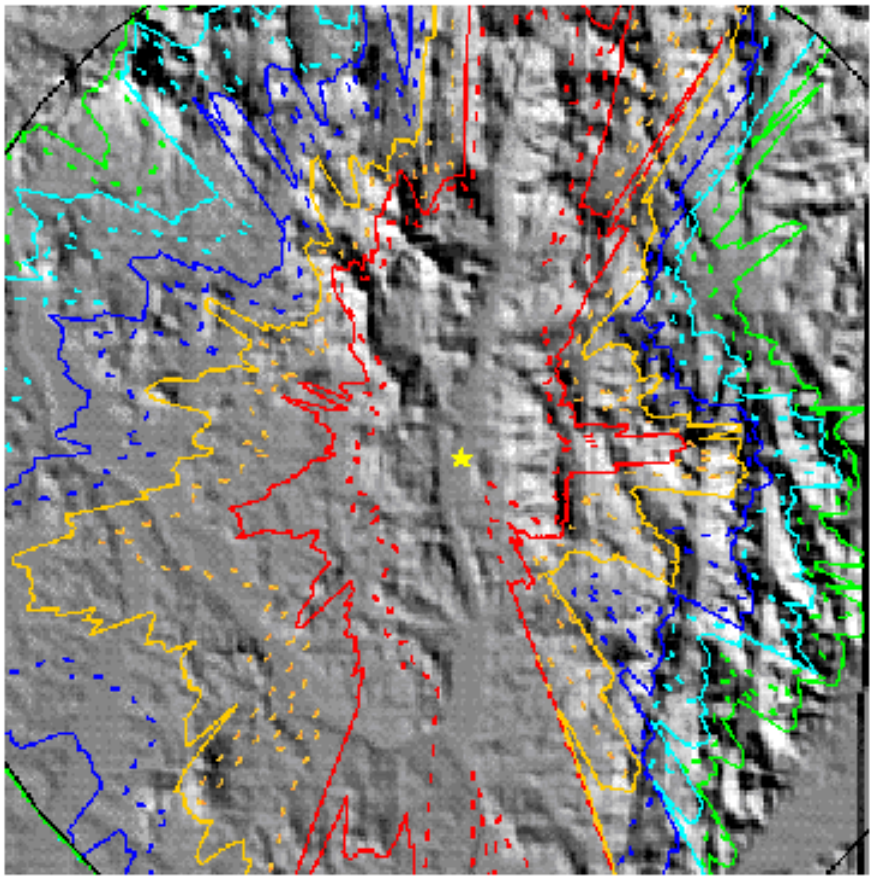
Legend

Site location
Masked area
Concentric circle

Site location:
Easting: 372533.0
Northing: 4137412.0
UTM zone: 52 Datum: WGS 84

Site elevation (m): 40.0
Antenna height (m): 2.0
Target altitude (m): 0.0
Elevation spacing (m): 94.0

Figure B-22. Masked-Area Plot (Shaded-Relief Background)



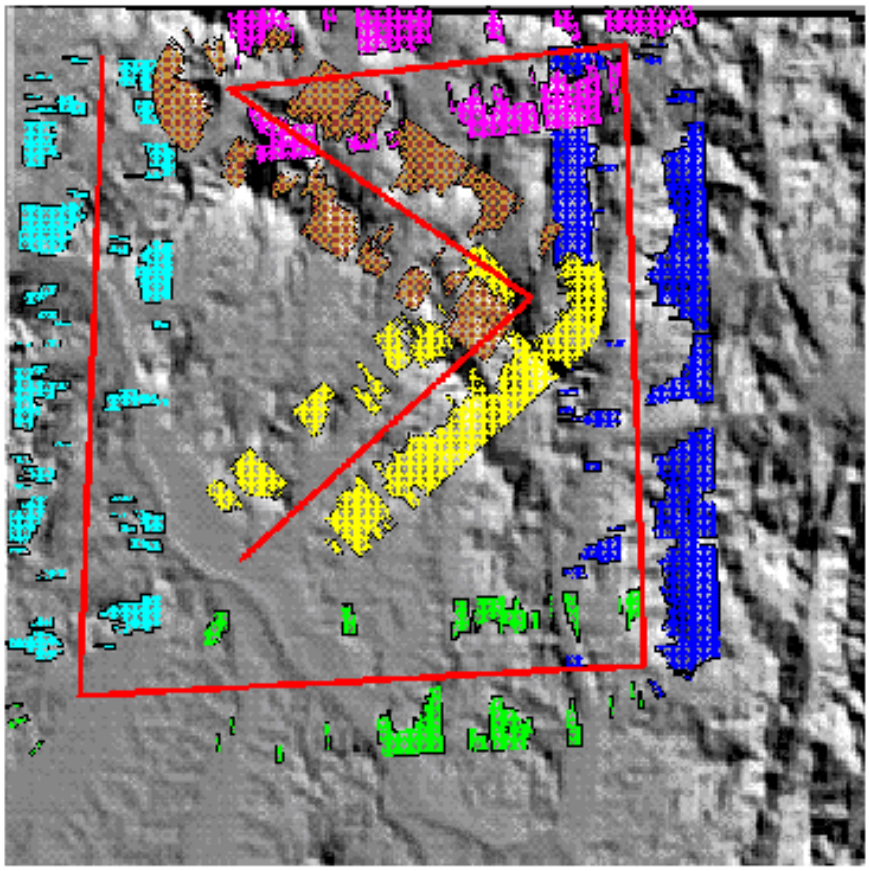
Legend

Target altitude above terrain

Site location	600 m
100 m	700 m
200 m	800 m
300 m	900 m
400 m	1,000 m
500 m	surveillance range

Site location:
Easting: 383206.0
Northing: 4137945.0
UTM zone: 52
Datum: WGS 84
Site elevation MSL (m): 70.0
Antenna height (m): 10.0
Elevation spacing (m): 94.0
Surveillance mode: Electronic

Figure B-23. Target Acquisition (Shaded-Relief Background)

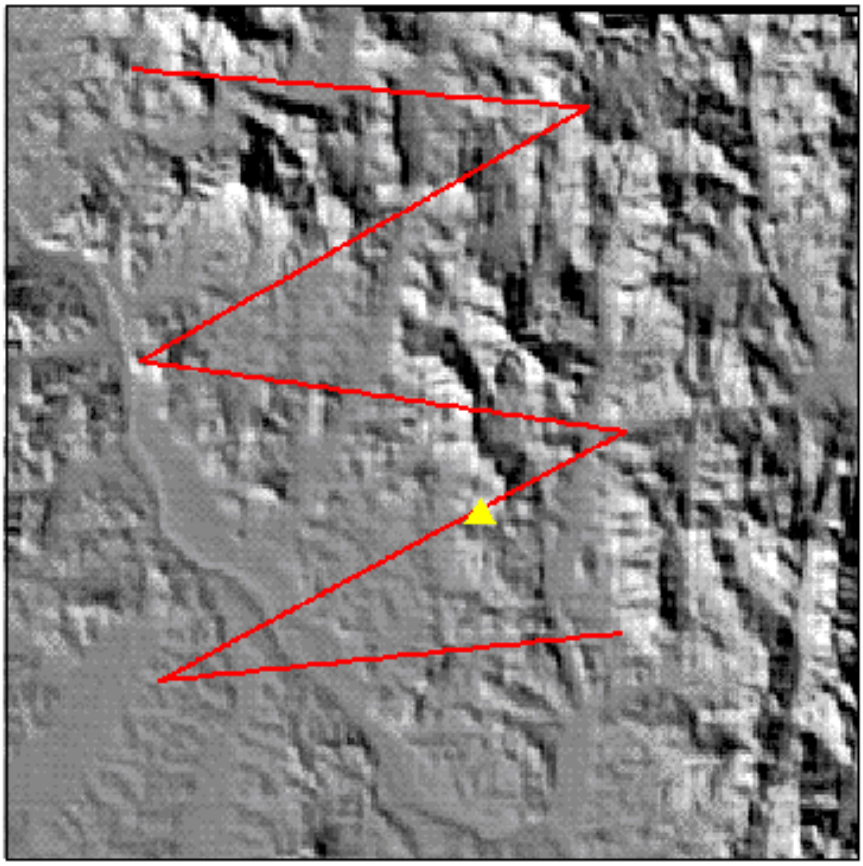


Legend

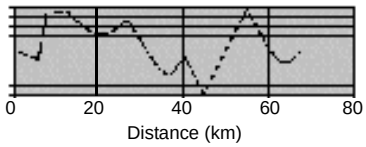
- Flight leg 1
- Flight leg 2
- Flight leg 3
- Flight leg 4
- Flight leg 5
- Flight leg 6
- Flight path

Aircraft altitude AGL (m): 150.0
Target altitude AGL (m): 100.0
Profile length (km): 2.2
Profile spacing (m): 100.0
Elevation spacing (m): 94.0

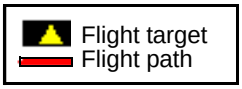
Figure B-24. Flight-Line Masking (Shaded-Relief Background)



Flight-line target profile

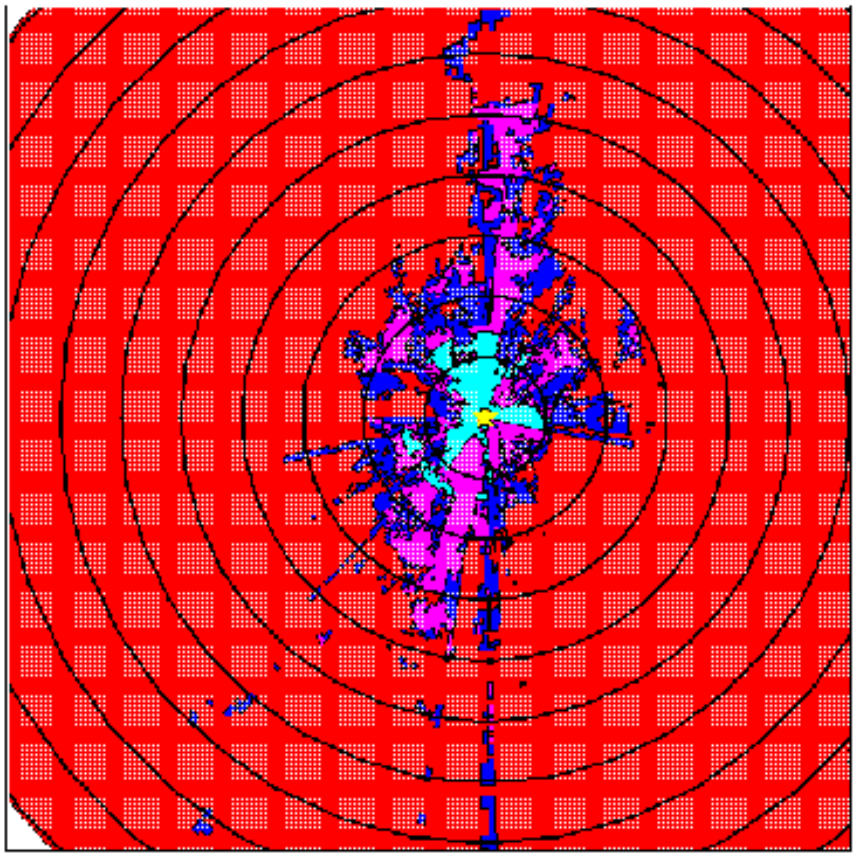


Legend



Target location
Easting: 380433.0
Northing: 4137339.0
UTM zone: 52 Datum: WGS 84
Target elevation MSL (m): 105.0
Target height (m): 100.0
Length of flight path (km): 67.4
Vertical exaggeration: 10.0

Figure B-25. Flight-Line Target Locator (Shaded-Relief Background)



Legend

- Site location
- 0 - 20 dB
- 20 - 40 dB
- 40 - 60 dB
- 60 - 80 dB
- 80 - 100 dB
- 100 - 120 dB
- 120 - 140 dB
- 140 - 160 dB
- Concentric circle

Site location:
Easting: 383489.0
Northing: 4138885.0
UTM zone: 52 Datum: WGS 84
Site elevation (m): 90.0
Transmitter height (m): 10.0
Receiver height (m): 10.0
Elevation spacing (m): 94.0

Figure B-26. Obstructed-Signal Loss

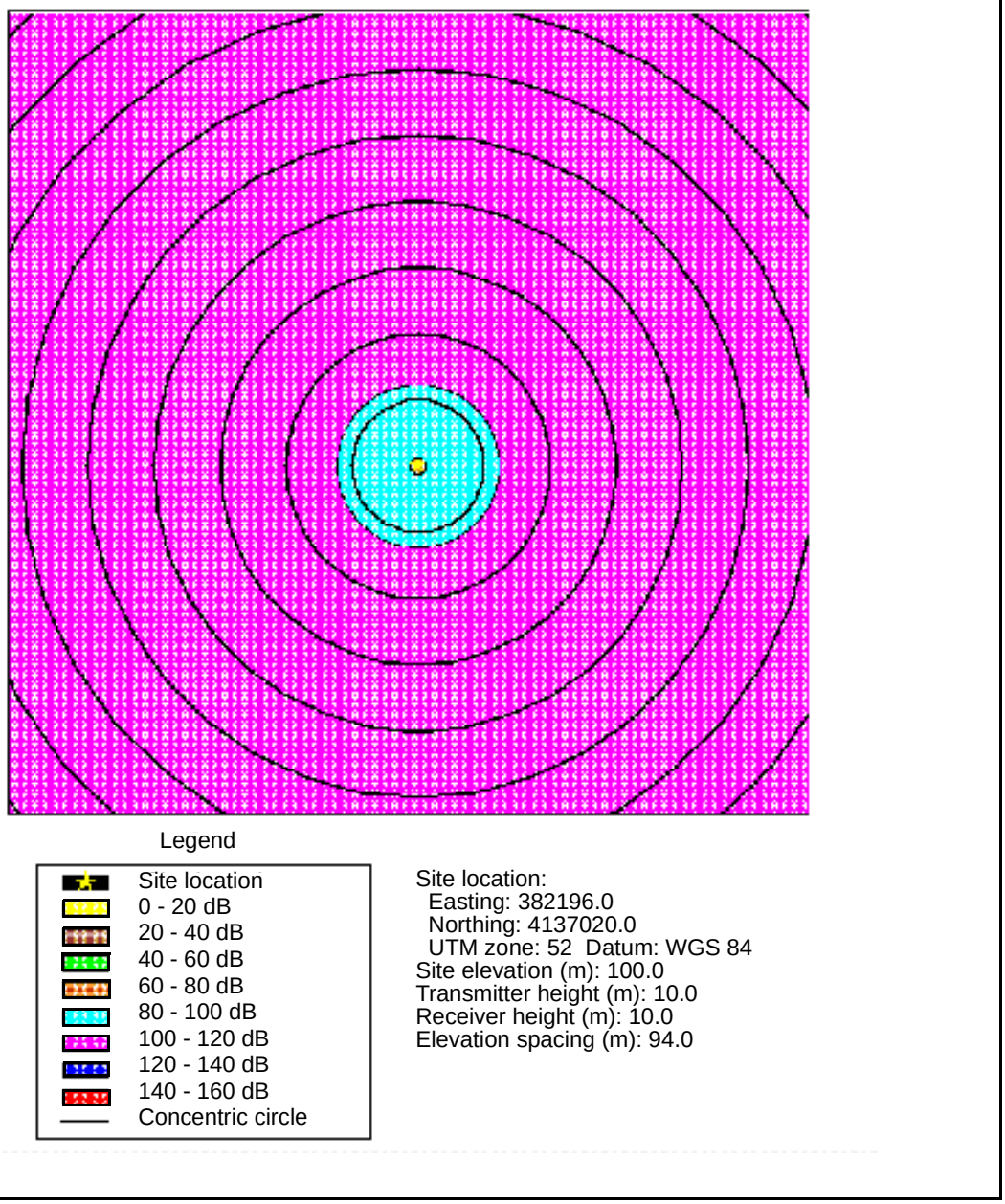
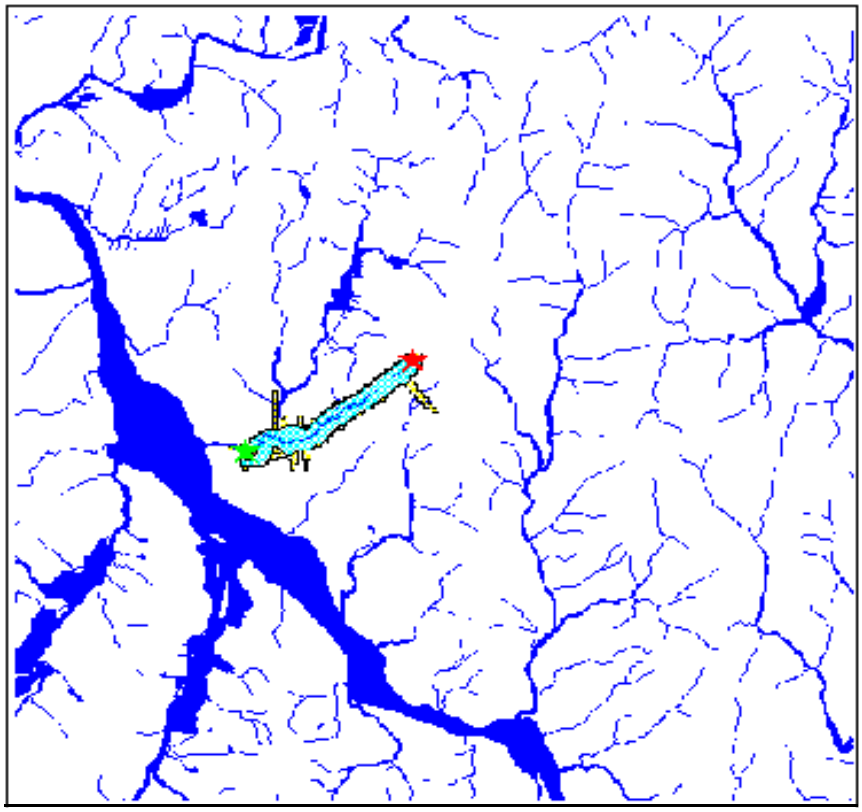


Figure B-27. Unobstructed-Signal Loss

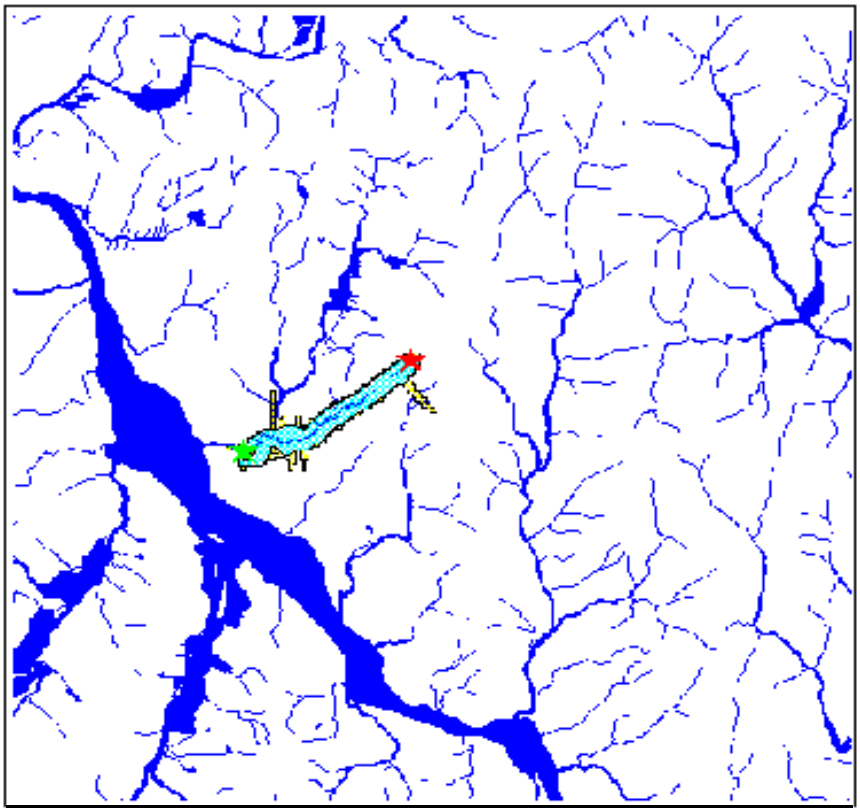


Legend

Dam
Downstream location
Flood zone
Surface drainage

Dam type: Earth dam
Dam location: xxxxxx xxxxxxx
Downstream location (UTM):
xxxxxx xxxxxxx

Figure B-28. Dam Break, Flood Zone

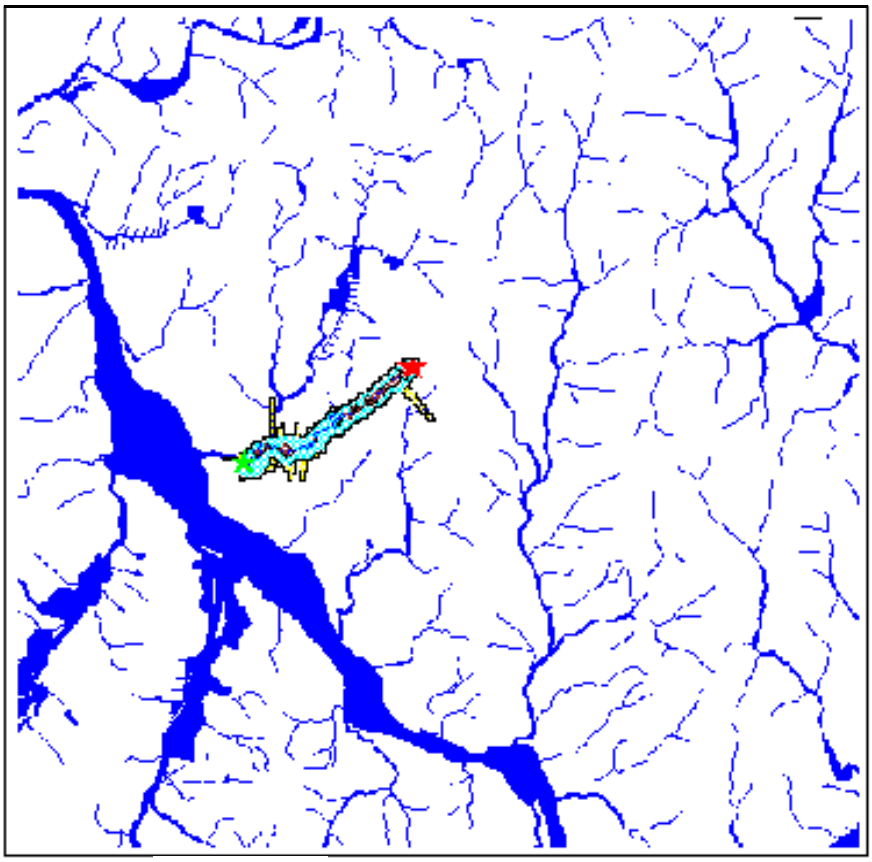


Legend

Dam
Downstream location
0 - 4 m
4 - 8 m
Surface drainage

Dam type: Earth dam
Dam location: xxxxxx xxxxxxx
Downstream location (UTM):
xxxxxx xxxxxxx

Figure B-29. Dam Break, Depth Contour



Legend

- Dam
- Downstream location
- 0 - 4 kph
- 4 - 8 kph
- 8 - 12 kph
- 12 - 16 kph
- Surface drainage

Dam type: Earth dam
Dam location: xxxxxx xxxxxxx
Downstream location (UTM):
xxxxxx xxxxxxx

Figure B-30. Dam Break, Velocity Contour

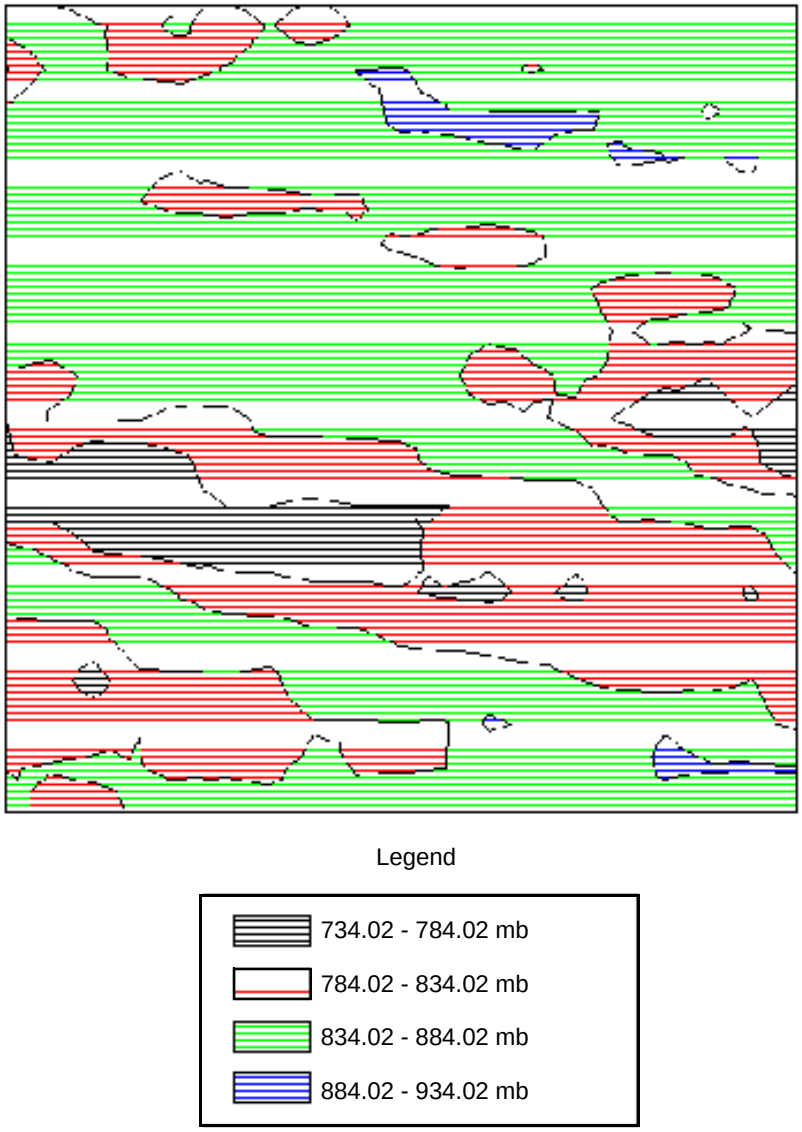
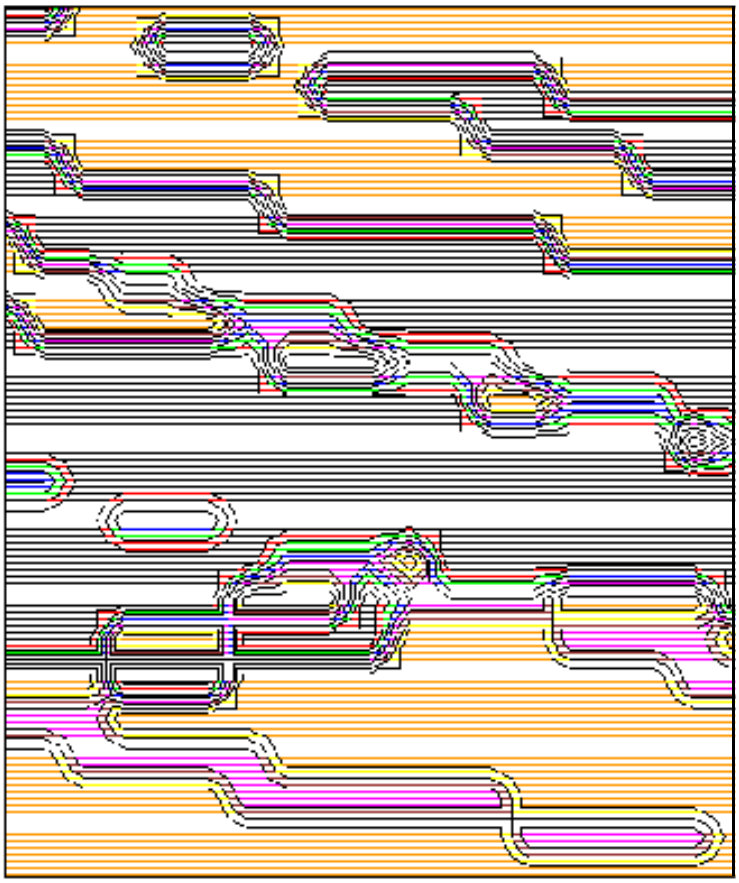


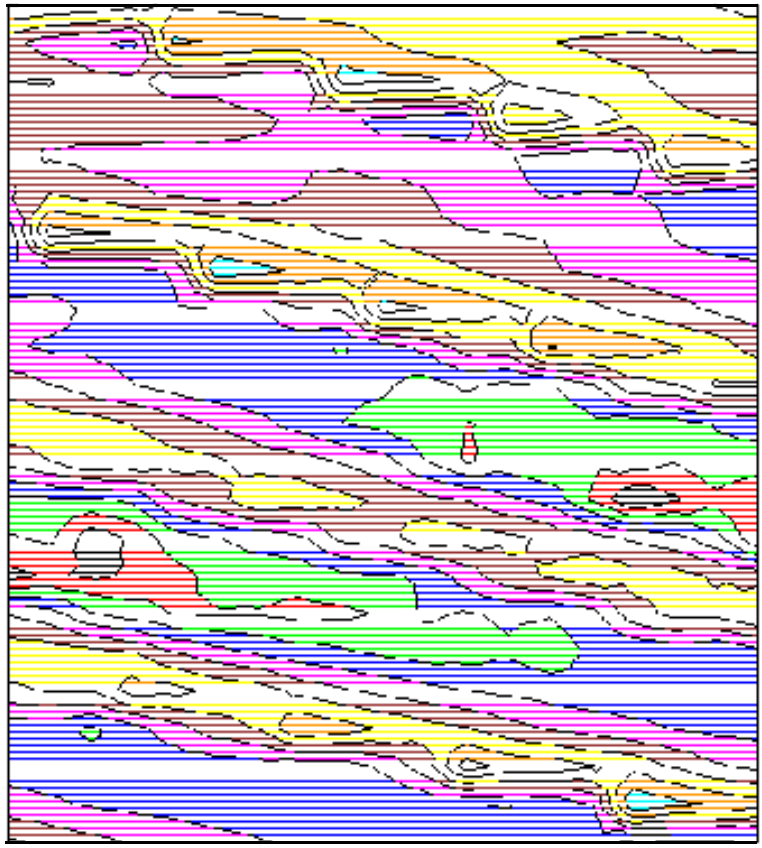
Figure B-31. Surface Pressure



Legend

00° - 45°
45° - 90°
90° - 135°
135° - 180°
180° - 225°
225° - 270°
270° - 315°
315° - 360°

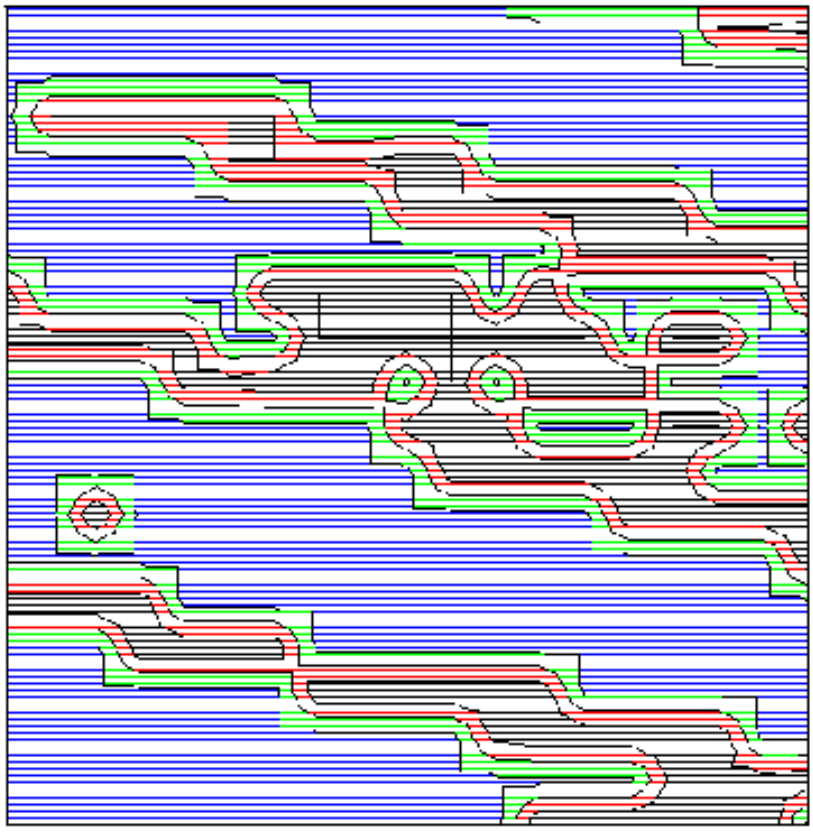
Figure B-32. Surface-Wind Direction



Legend

-1.27° - 0.27° C
0.27° - 0.73° C
0.73° - 1.73° C
1.73° - 2.73° C
2.73° - 3.73° C
3.73° - 4.73° C
4.73° - 5.73° C
5.73° - 6.73° C
6.73° - 7.73° C

Figure B-33. Soil Temperature



Legend

16.09 - 21.09 km
21.09 - 26.09 km
26.09 - 31.09 km
31.09 - 36.09 km

Figure B-34. Visibility

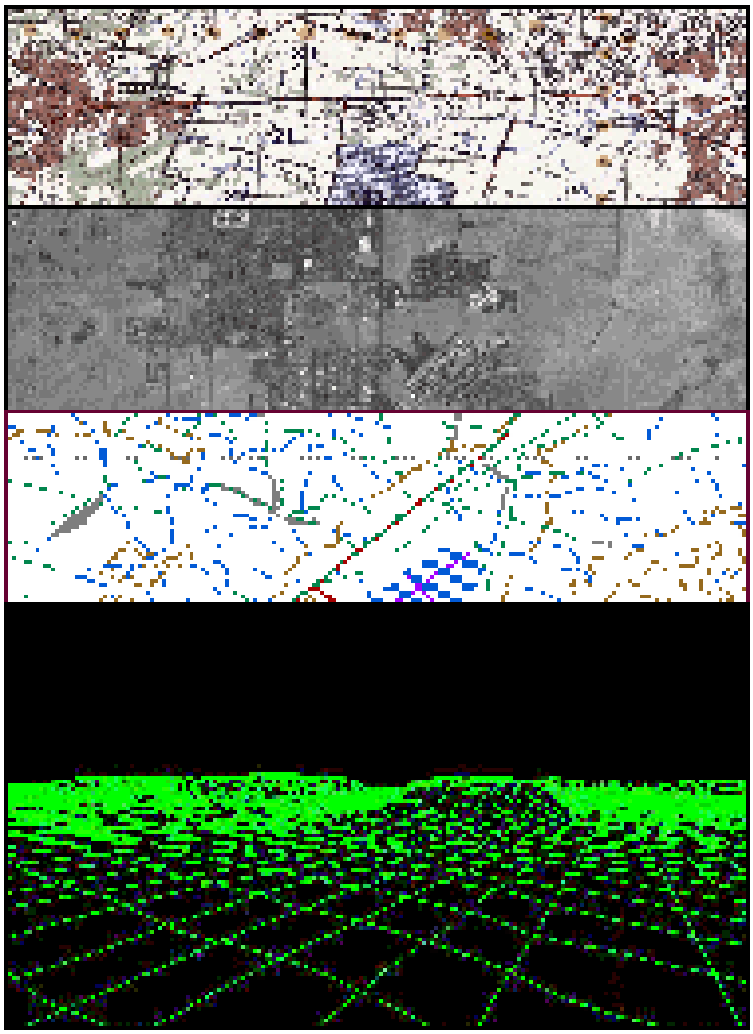


Figure B-35. Digital Data Viewing

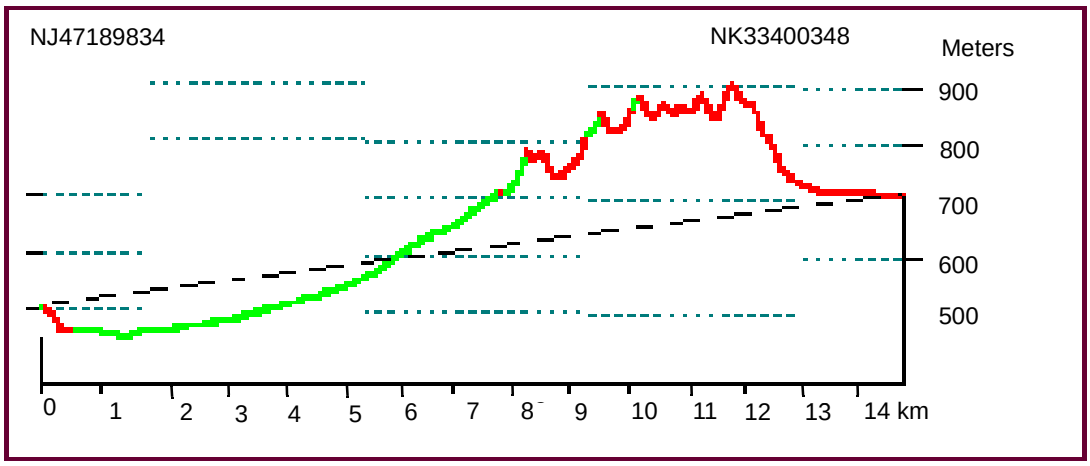


Figure B-36. Line of Sight

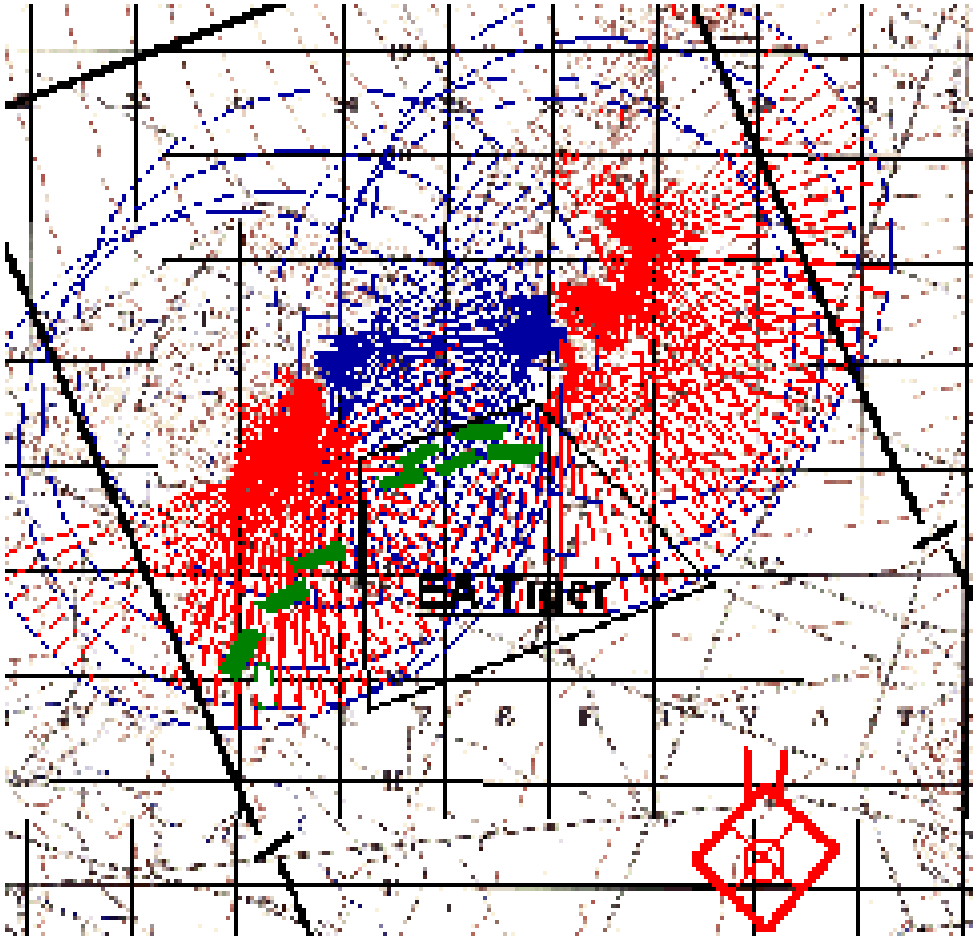


Figure B-37. Weapons Fans

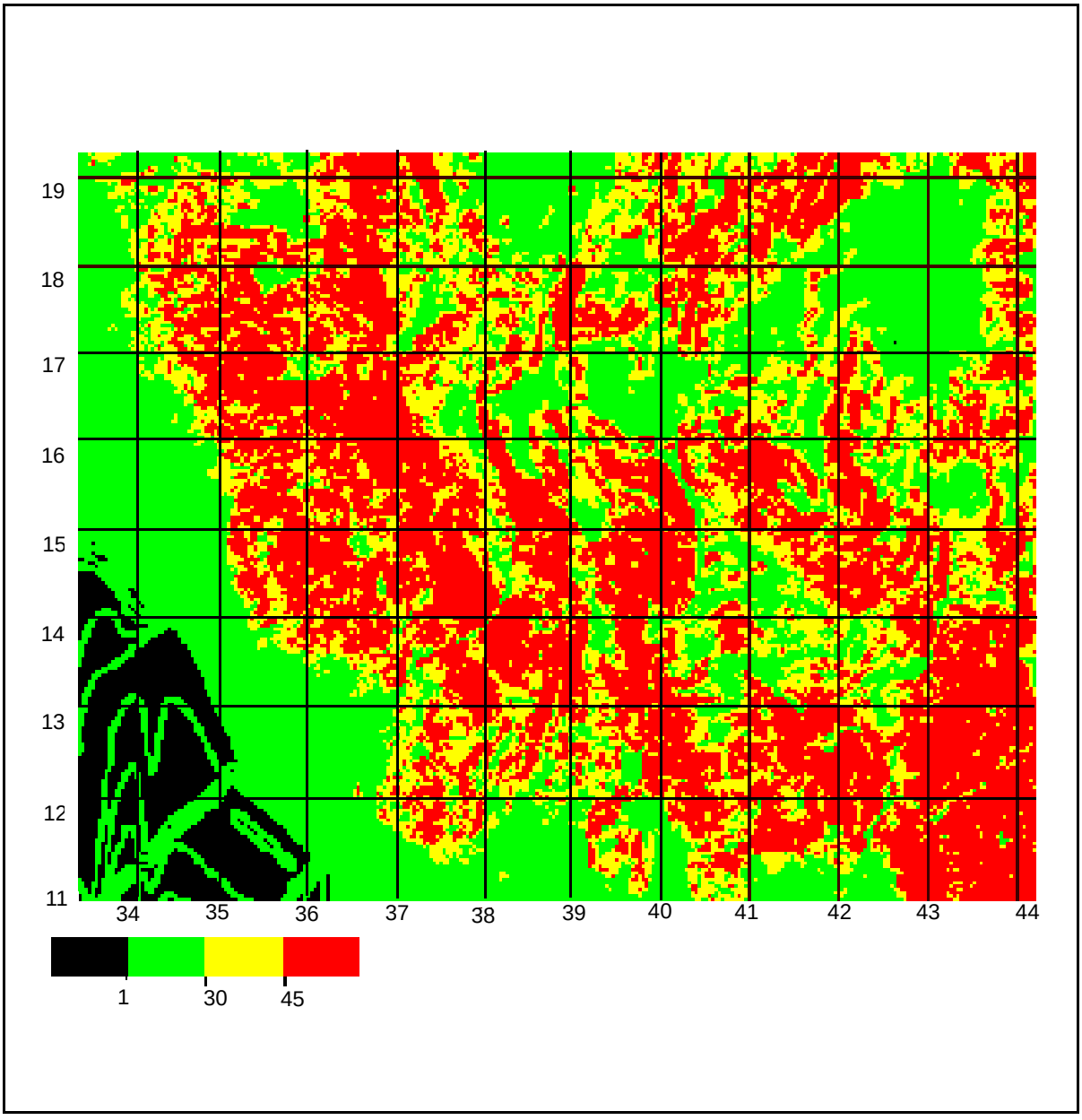


Figure B-38. Slope Map

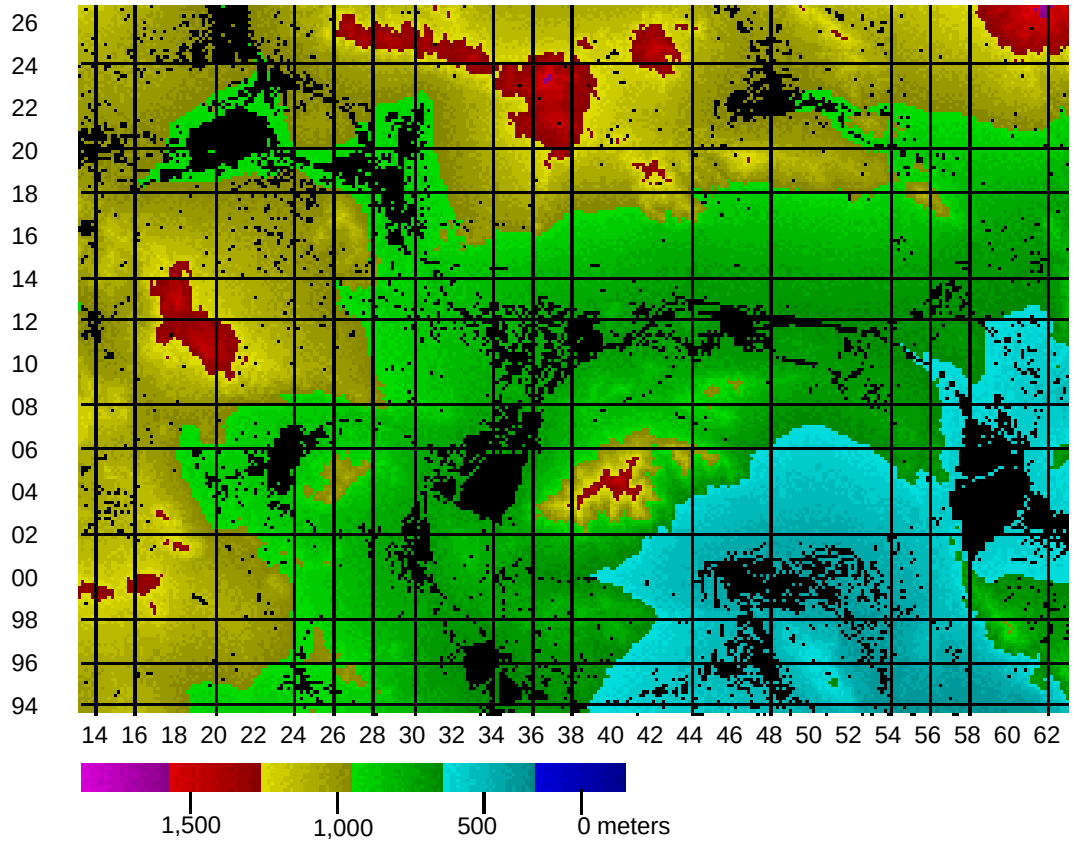


Figure B-39. Terrain Category

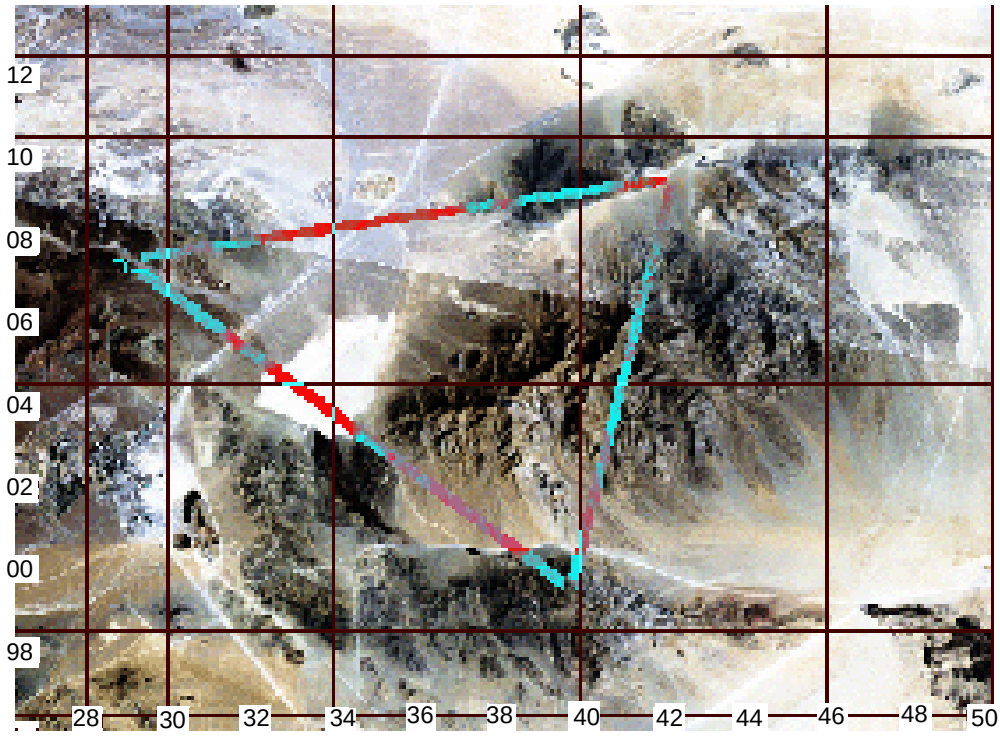


Figure B-40. Perspective View

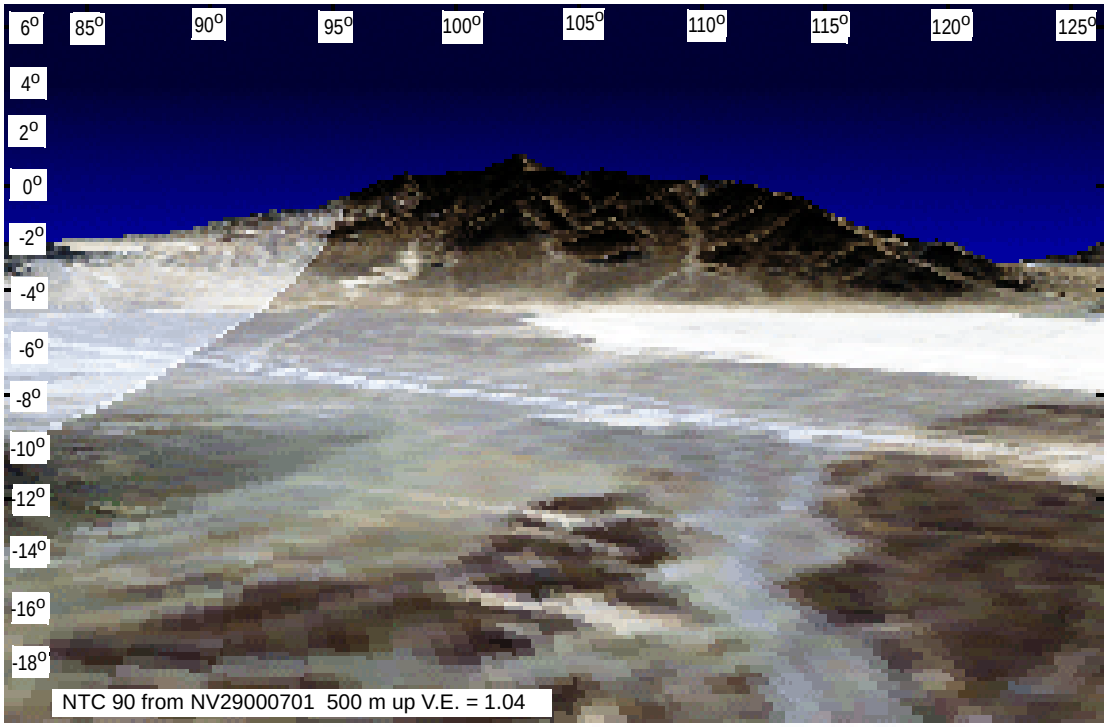


Figure B-41. Perspective View

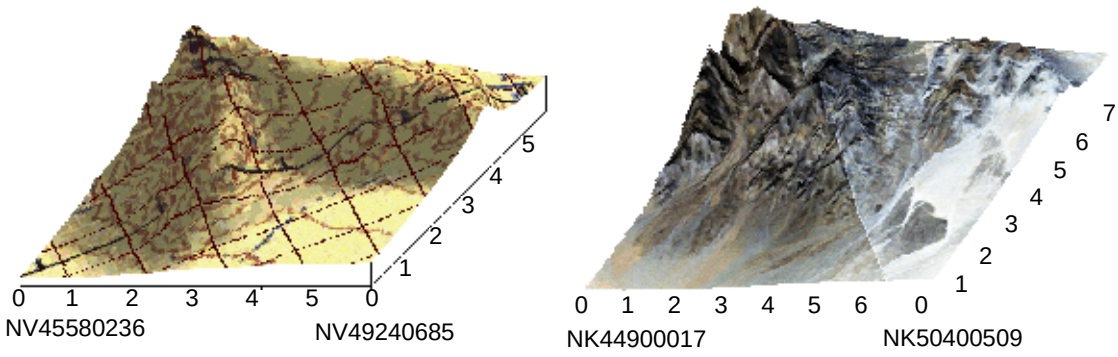


Figure B-42. Oblique View

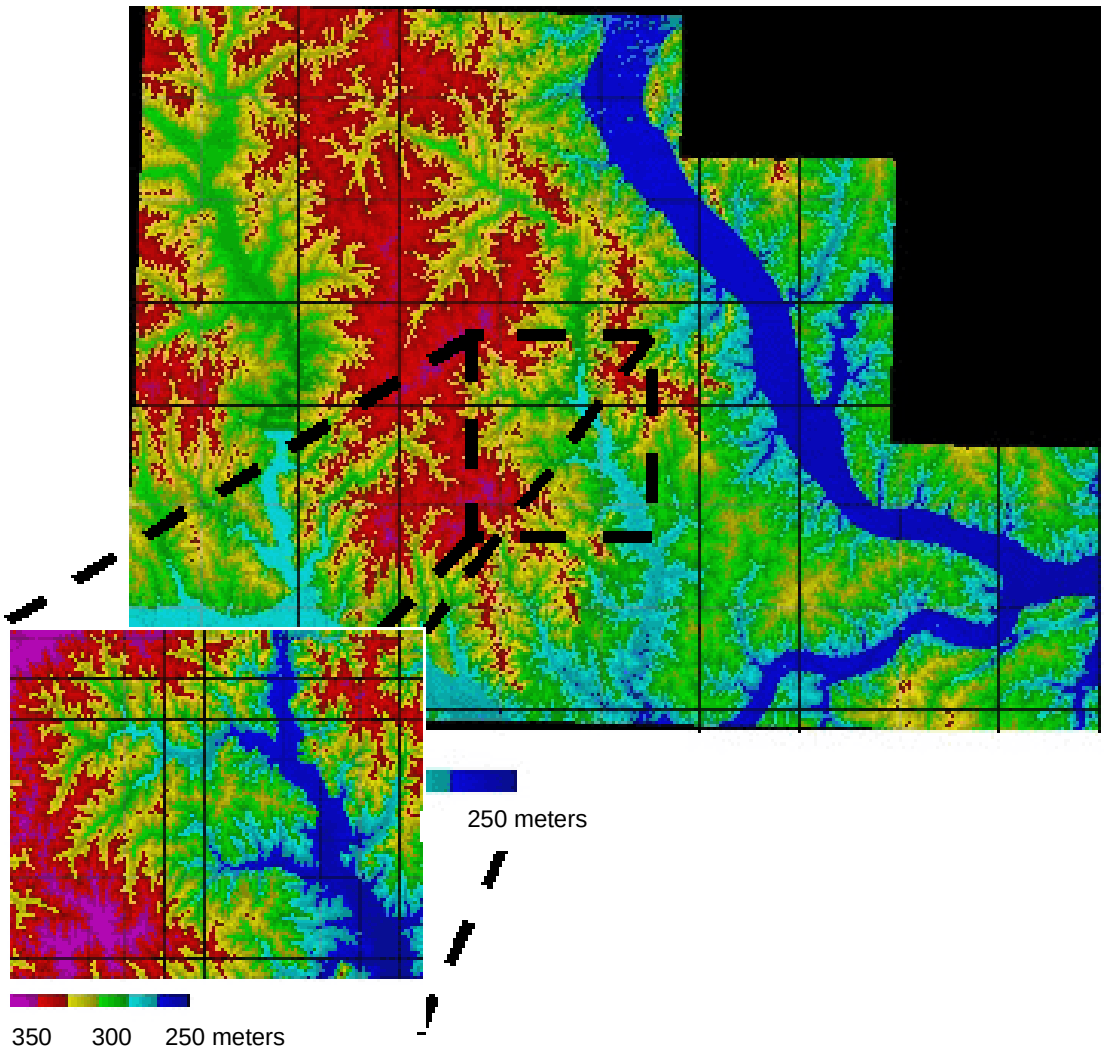


Figure B-43. Elevation Merger

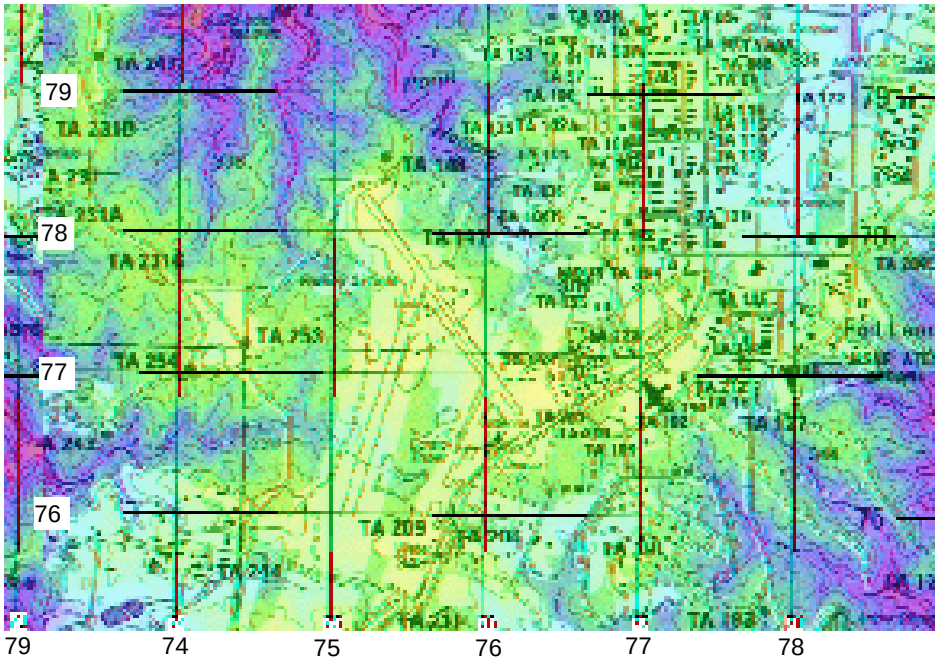


Figure B-44. Elevation/Slope Merger With Maps

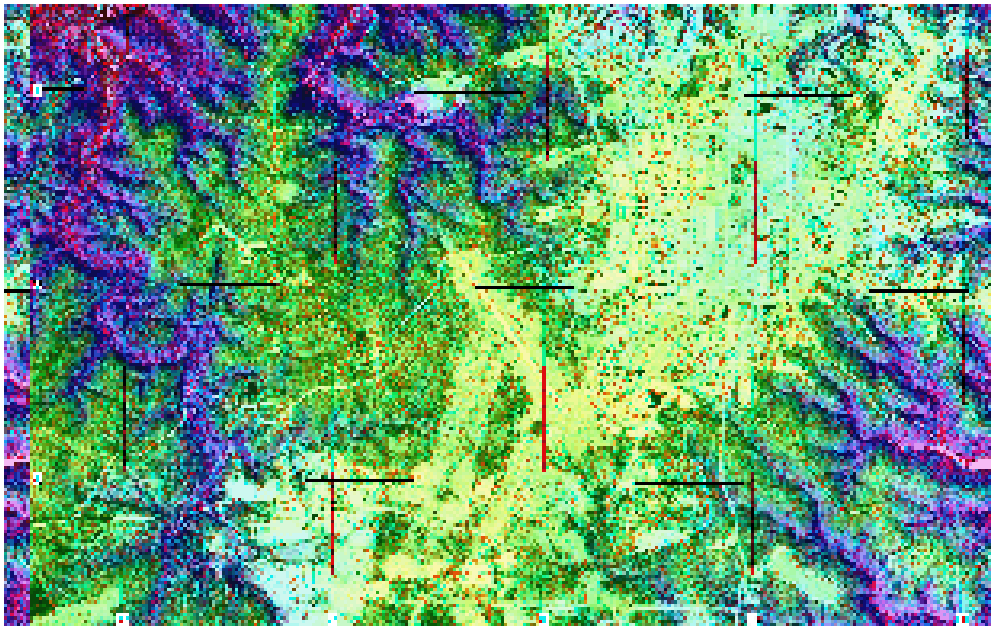


Figure B-45. Elevation/Slope Merger With Imagery

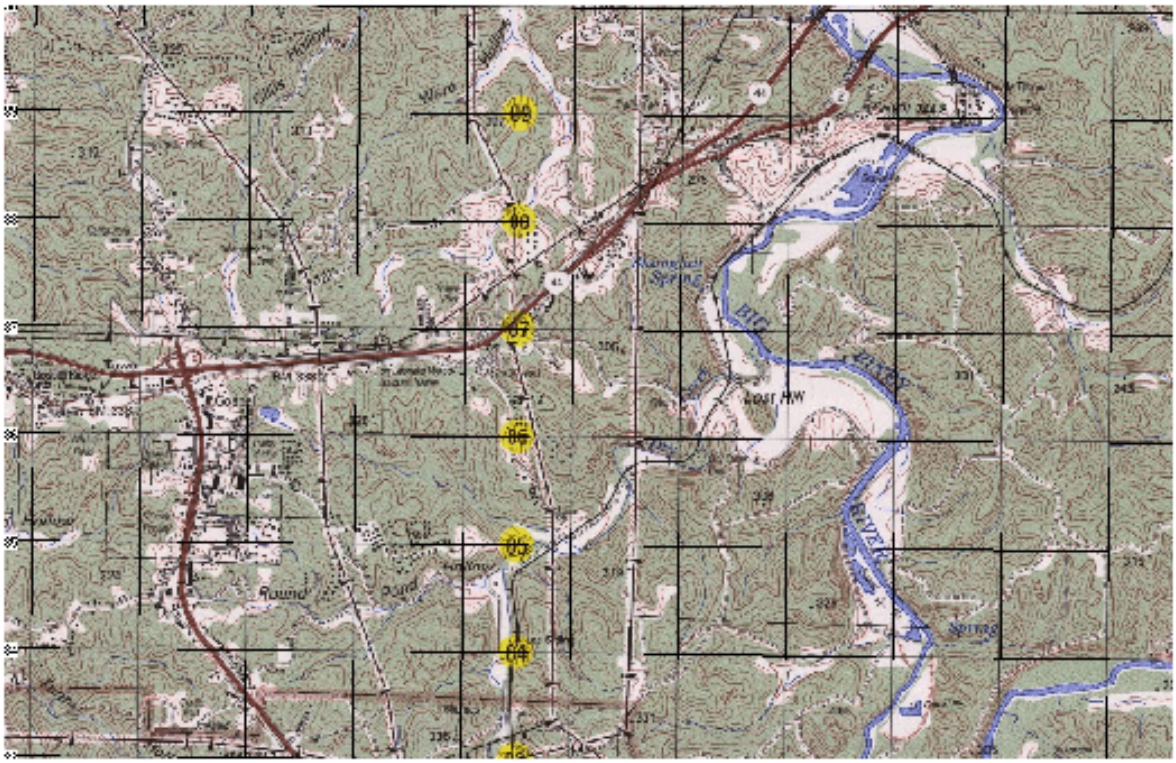


Figure B-46. Topographic Line Map

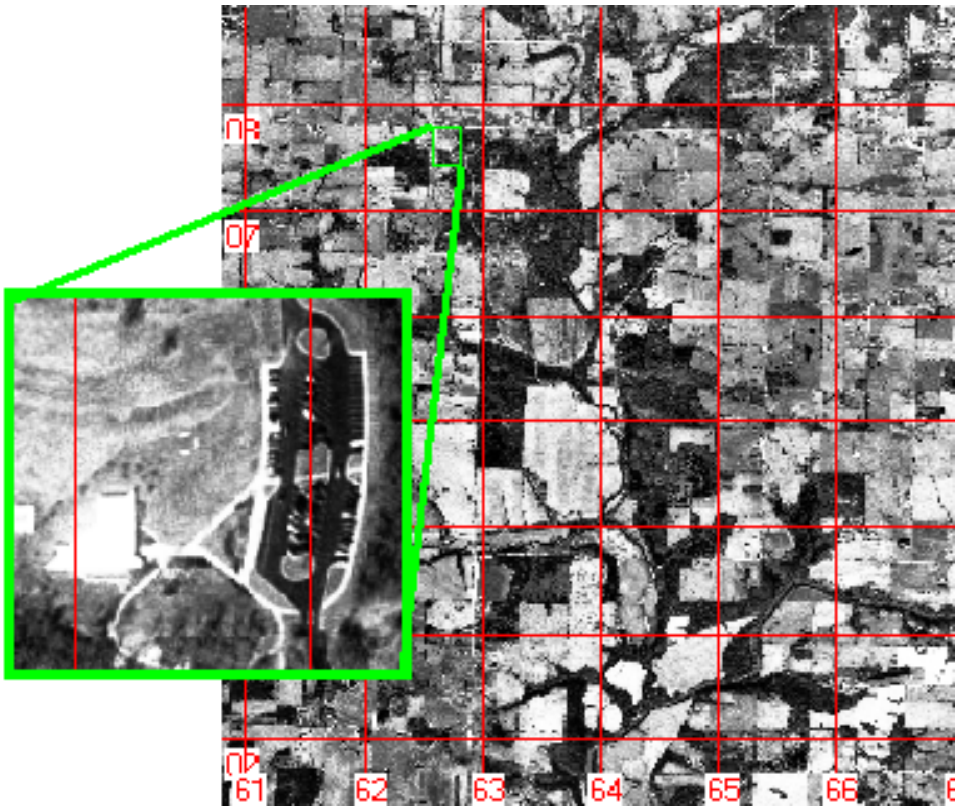


Figure B-47. CIB 10- and 5-Meter Resolution

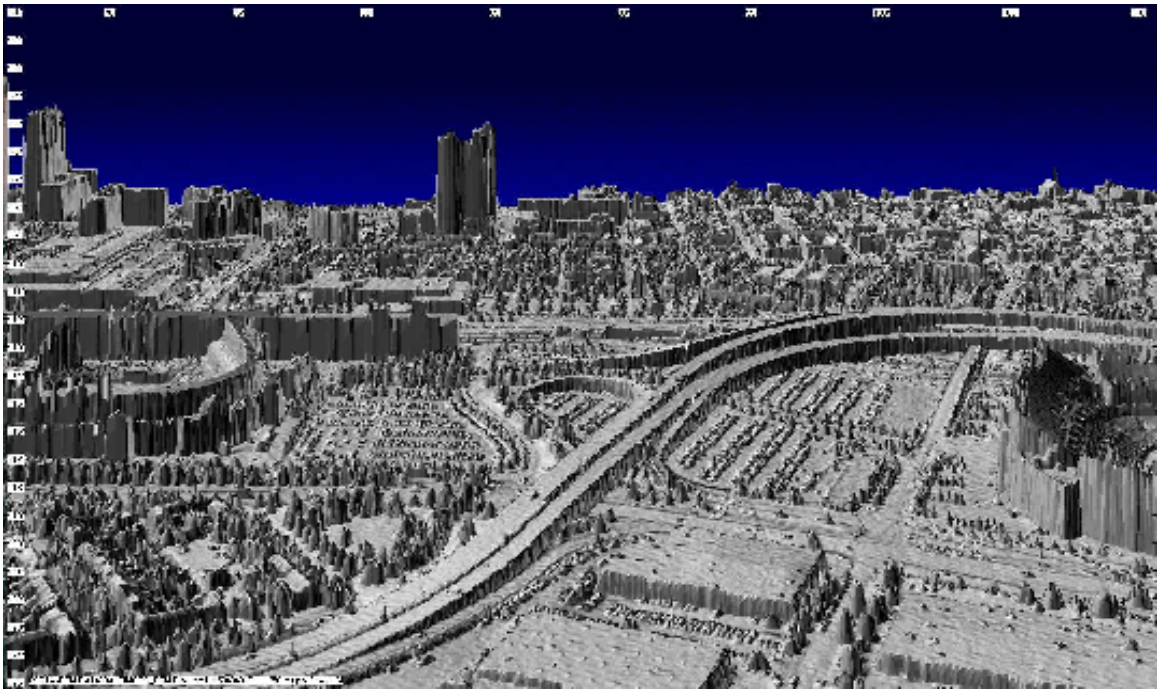


Figure B-48. High-Resolution Elevation Data (1-Meter Light Detection and Ranging)

Appendix C

Future Operational Capabilities

The FOC serve as the basis for the TRADOC requirements-determination process (to include conducting studies and experimentation). The FOC provide the focus for the Army's science and technology programs. The following paragraphs outline some of the specific FOC that focus on topographic operations and terrain visualization.

INFORMATION-MANAGEMENT ENVIRONMENT

C-1. Information management (IM) provides the capability to receive and process customer requirements; order imagery, imagery-and-geospatial-information (IGI) products, or other information; schedule and assign exploitation tasks; provide status reports; and manage the delivery of information through Army Imagery and Geospatial Information and Services (AIGIS) or the US Imagery and Geospatial Information Service (USIGS). Information management also provides the services that monitor and direct activity and information flow throughout AIGIS/USIGS. This capability accepts customer requirements for creating new information and assigns tasks to one (or several) of three other FOC (exploitation, archive and dissemination [A&D], and collection and processing [C&P]) to obtain or create required mission-specific information. The IM capability tracks the status of all requests and assigned tasks so that users can monitor the progress toward satisfying their information needs. It also exchanges information with entities beyond AIGIS (such as the ABCS and USIGS) in a common format. These include tip-offs to support cross-cueing with other intelligence disciplines and delivery instructions (push, pull, priority, and profile) that facilitate the management of communications resources shared by AIGIS and other enterprises. Seven key and enabling elements support this FOC.

INFORMATION-REQUIREMENTS MANAGEMENT

C-2. The information-requirements-management (IRM) element provides the capabilities for receiving, validating, prioritizing, and entering all AIGIS information requirements. This element provides the initial work flow and breaks down orders into collection, processing, exploitation, and dissemination requirements. It includes a common shared-requirements database that records all AIGIS/USIGS requirements for collecting, processing, exploiting, and disseminating. The shared-requirements database interacts with a greater all-source intelligence-community distributed-requirements database. The IRM element provides—

- Instructions for the type of data to be collected and processed to the information-collection-management (ICM) element.

- Instructions on the information and products to be generated by an exploitation asset to the information-production-management (IPM) element.
- Delivery instructions to the information-delivery-management (IDM) element, describing how information must flow through AIGIS as requirements are satisfied and orders are fulfilled.

INFORMATION-COLLECTION MANAGEMENT

C-3. The ICM element manages collection requirements received from the IRM element and sends taskings to collection sources to satisfy the requirement. The ICM enabler allows the IRM element to graphically view the collection assets available and their capabilities. It also provides an indication on collection nominations being successfully fulfilled. The ICM element coordinates the assignment of collection requirements across multiple collection sources (including national, airborne, ground, commercial, and other information sources). It does not control the specific collection assets or resources of these sources; it simply tasks them based on their capabilities and current availability. Specific planning for using and scheduling a collection source's assets remains with the owner of that resource. Status messages concerning a source's current operational status, resource usage, and progress toward satisfying assigned tasks are passed back to the ICM element. The ICM element also works with the cross-cueing element for automated collection tasking.

INFORMATION-PRODUCTION MANAGEMENT

C-4. The IPM element accepts, manages, tracks, and assigns production requirements received from the IRM element. The IPM element manages these requirements and sends production taskings to exploitation environments that have the capability and capacity to satisfy the requirement. The IPM element coordinates the production assignment across multiple exploitation environments throughout its administrative domain. It does not control the specific job assignment or work-flow management for exploitation assets; it simply tasks the exploitation environment based on its skills, capabilities, and current availability. Specific planning for using and scheduling exploitation resources remains with the owner of those resources. Status messages concerning an exploitation environment's operational status, resource availability, and progress toward satisfying assigned tasks are passed back to the IPM element from the exploitation environment's work-group-management element.

INFORMATION-DELIVERY MANAGEMENT

C-5. The IDM element controls the flow of information through AIGIS/ USIGS. It accepts delivery requirements and sends delivery instructions to the appropriate information sources, libraries, archives, and exploitation environments. The IDM element receives the delivery status from AIGIS/ USIGS libraries. This allows informed decisions to be made about the delivery of information, such as the time of delivery, the selection of the network, and the selection of the source location (if the data exists in multiple locations). The IDM element will contain a rule set for executing decisions that may

change due to different scenarios. It will also have the capability to interface with the WIN and Defense Information System Network (DISN) communications-management enabler for managing communications support provided by the Army Signal Corps and the Defense Information Systems Agency (DISA). As the IDM element receives the delivery status from delivery and library systems used by AIGIS/USIGS, it will collect metrics and forward the requirement status to the WIN/DISN communications-management element. The IDM element also maintains delivery profiles. As user information changes, the IRM element provides this information to the IDM element, which maintains tailored delivery profiles for its users. These profiles are used by AIGIS/USIGS library components to support standing retrieval functions.

WORK-GROUP MANAGEMENT

C-6. The work-group-management element manages taskings assigned to the exploitation environment. It assigns jobs, allocates resources, and tracks the tasking's progress. The work-group-management element receives assignments from the IPM element and manages their allocation and execution within the work group. A work-group-management component may support one or more exploitation environments, but generally, each environment will have access to its services to manage job execution and resource allocation within the environment.

CROSS-CUEING MANAGEMENT

C-7. Cross-cueing management enables data sharing and automatic collection tasking between intelligence and battlefield systems for the purpose of alerting these systems to a given, predefined activity tip-off. The exchange of tip-off information extends beyond AIGIS/USIGS to the other intelligence and battlefield functional areas.

WIN/DISN COMMUNICATIONS MANAGEMENT

C-8. The WIN/DISN communications-management element is an Army- and DISA-provided service that optimizes the use of communications networks. The IDM element interfaces with the ICM element to manage the flow of IGI through the WIN and the DISN.

IGI C&P ENVIRONMENT

C-9. The IGI C&P capability collects and processes source information required to produce imagery, imagery-system-derived measurement and signature intelligence (MASINT), imagery intelligence, and GI. It obtains imagery (in various spectra) and other data with associated support data (such as coordinates and ephemeral data). The C&P functions gather collected data from sensor-specific signals and convert it into standard forms and formats that are useful for either direct interpretation by customers or subsequent exploitation and product generation using the exploitation element. This processed data is provided to the A&D element for cataloging, storage, and delivery to customers. The C&P element receives taskings from the IM environment and provides processed data to the A&D element for

delivery and storage. The C&P element provides the IM element with the collection status as the tasks are accepted, scheduled, executed, and completed. It also provides information and imagery to AIGIS/USIGS from airborne (theater, tactical, and national airborne collection), commercial (commercial imagery service providers), national, and other IGI sources. Other information sources include, but are not limited to, interferometric synthetic aperture radar (IFSAR), names data, bathymetric data, navigational data, geodetic data, geophysical data, aeronautical data, gravity data, foreign and civil imagery, maps, and reference material. Seven key and enabling elements support this FOC.

AIRBORNE C&P

C-10. Airborne C&P includes the sensor, platform-image-processing (onboard or ground-based), image-screening, and other capabilities required to collect and capture imagery in theater. This element will collect and process imagery and imagery screening on the collection platform or on the ground before its acceptance by a library or a colocated exploitation environment. The screened imagery is delivered to the exploitation and production environment where exploited products are developed. The screened imagery is also provided to AIGIS/USIGS libraries for storage and dissemination to customers.

AIRBORNE MISSION MANAGEMENT AND PLANNING

C-11. Airborne mission management and planning supports airborne C&P operations. This element receives taskings from the ICM element and distributes them to the C&P resources under its control. It is controlled by operational elements to meet mission objectives. The airborne-mission-management-and-planning element provides the airborne C&P element with critical information (such as mission planning, mission control, navigation routes, flight control, flight status, and sensor-control data).

THEATER DOWNLINKED-IMAGERY PROCESSING

C-12. Theater downlinked-(TDL) imagery processing provides the capability to receive, process, and screen in-theater imagery on the ground before its acceptance by a library or a colocated exploitation environment. The screened imagery is delivered to the exploitation and production environment where exploited products are developed. The screened imagery is also provided to AIGIS/USIGS libraries for storage and dissemination to customers.

COMMERCIAL C&P

C-13. The components within the commercial-imagery-sources environment are largely not AIGIS/USIGS components, but are private-sector service providers. The specific arrangements of components within these service providers' enterprises are based on their own business rules and needs. However, it is assumed that service providers will offer their products for delivery either electronically or as physical media (digital or hard copy) and that they will provide access for users to search their holdings and order imagery and products. Select AIGIS units will have the capability to receive commercial imagery downlinked to their locations. Units requesting commercial imagery are responsible for paying for this imagery directly or

having the imagery paid for through a DOD license agreement. Imagery purchased by NIMA or other DOD organizations will be licensed for use across the DOD/Title-50 communities. If broader access (such as a coalition) is required, broader licenses may be purchased. Licensed commercial imagery will be stored in the Commercial Satellite Imagery Library, which will control enterprise-wide access to ensure that only those licensed for its use are allowed to retrieve the data.

SERVICE-PROVIDER RESOURCE MANAGEMENT

C-14. Service-provider resource management is the interface provided by the vendor for ordering commercial imagery. It allows commercial imagery to be exploited in a full range of military environments (strategic to tactical).

GEODETIC AND TOPOGRAPHIC SURVEY

C-15. A geodetic and topographic survey provides highly accurate positioning and orientation information in the form of SCPs used for navigation aids, fire, and imagery control, and for airport-obstruction chart surveys. Differential GPS sites are established to assist in precise navigation.

ASSISTED/AUTOMATED TARGET RECOGNITION, ASSISTED/AUTOMATED FEATURE EXTRACTION, AND AUTOMATED CHANGE DETECTION

C-16. Assisted/automated target recognition (ATR), assisted/automated feature extraction (AFE), and automated change detection (ACD) are components of both IGI C&P and exploitation. They are capabilities needed to improve the capacity, efficiency, and timeliness of AIGIS. Future volumes of imagery have the potential to overwhelm the AIGIS exploitation work force and systems that do not use these new methods. The ATR and ACD components will be used for automatic target cueing and image triage. Large volumes of imagery can be searched, prioritized, and enhanced in a tailored manner before being presented to an analyst. In some cases, reports can be drafted and databases can be updated automatically. Similarly, the AFE component will be used to locate, bound, identify, and attribute objects of interest in support of GI production. The ATR, ACD, and AFE capabilities will be provided as centralized preprocessing services and as flexible, tailorable work-group tools.

IGI EXPLOITATION ENVIRONMENT

C-17. The IGI-exploitation-environment capability produces imagery intelligence and GI. It provides the capabilities and services that allow AIGIS personnel (particularly imagery analysts, topographic analysts, and other GI specialists) to generate imagery intelligence and geospatial information and products to support the military decision-making process (MDMP). To support planning, the exploitation environment provides services for internally managing assets (such as personnel and equipment), tracking a task's status, assembling work packages, and supporting other work-flow-management functions. The exploitation environment may receive IGI directly from the C&P, or it may retrieve source information from the A&D element to support its information- and product-generation processes. To facilitate the execution

of assigned information-generation tasks, the exploitation environment provides tools to establish a collaborative environment to manipulate, analyze, and fuse information from various sources. This information is then used to create new imagery intelligence and geospatial information and products. This environment includes exploitation and A&D components. Each exploitation environment has an assigned set of tasks and allocated resources to support those tasks. Exploitation environments may be set up hierarchically and may range in size from a single-person work group to an exploitation center. An environment may be physically colocated and unified, or it may be virtually unified and physically distributed across the imagery and geospatial community's organizations and sites. The exploitation environment is a flexible work unit with direct access to the following functional enablers:

- Work-group management.
- Exploitation tools.
- Dissemination and retrieval services.
- Media generation.

C-18. While some exploitation environments may not include all enablers, most of them will. A single enabler could be shared among multiple exploitation environments, with the level of service granted or guaranteed to the environment governed by the operating rules defined and enforced by the work-group-management component. Exploitation environments will exist within the Army at service level, Army-component commands, and echelons corps and below. Exploitation tools will enable the necessary functionality and performance to exploit and produce imagery intelligence and GI. Exploitation tools include scalable hardware and software with the functionality and performance necessary to exploit imagery and other sources and to produce imagery intelligence and geospatial information and products. Five exploitation enablers support this FOC.

ATR, AFE, AND ACD

C-19. The ATR, AFE, and ACD elements are components of both the IGI exploitation and C&P capabilities. These elements are needed to improve the capacity, efficiency, and timeliness of AIGIS. Future volumes of imagery have the potential to overwhelm the AIGIS exploitation work force and systems without these new methods. The ATR and ACD components will be used for automatic target cueing and image triage. Large volumes of imagery can be searched, prioritized, and enhanced in a tailored manner before being presented to an analyst. In some cases, reports can be drafted and databases can be updated automatically. Similarly, the AFE component will be used to locate, bound, identify, and attribute objects of interest in support of GI production. The ATR, ACD, and AFE elements will serve as the centralized preprocessing services and as flexible, tailorable work-group tools.

DATA PREPARATION

C-20. Data-preparation capabilities provide the means to acquire imagery, imagery intelligence, geospatial data and associated metadata; access source materials for content and completeness; identify shortfalls; augment source

materials with auxiliary data; assemble work packages for exploitation; and perform the imagery-screening function associated with motion and video imagery exploitation. The data-preparation component also transforms legacy products into usable formats. It provides for automated ortho- and geo-rectification of selected national and theater images. This will not delay the immediate analysis of the imagery.

DATA ANALYSIS

C-21. The data-analysis element provides the capability to display and manipulate imagery and geospatial data for analysis and to extract, integrate, and conflate information. The data-exploitation component uses a suite of imagery and geospatial-imagery analysis, information-extraction, and information-validation tools to support the extraction of imagery intelligence and GI from various sources.

INFORMATION GENERATION

C-22. The information-generation element provides the capability to use multiple types of input to prepare finished GI and imagery intelligence in standard and user-specified formats. The information-generation element provides final quality control, validation, and security review and the release of data produced by AIGIS entities.

EXPLOITATION SUPPORT

C-23. Exploitation support provides common-processing functions used in data preparation, data exploitation, and information generation. It provides local exploitation task management and data control. Exploitation support also performs exploitation-status collection and reports results to the work-group management element.

A&D ENVIRONMENT

C-24. The A&D capability provides seamless access to AIGIS/USIGS. It also provides the capability to store, catalog, retrieve, replicate, and disseminate information across AIGIS/USIGS. The A&D element receives imagery, imagery intelligence, and GI from both the C&P element and the exploitation environment. This element responds to the customer with the requested imagery or geospatial information and products, or it indicates that the request cannot be filled with existing information. The A&D element receives delivery instructions from the IM element to coordinate information movement and storage across AIGIS/USIGS.

STORAGE SERVICES

C-25. Storage services maintain the information holdings of AIGIS/USIGS and ensure that these holdings are available to authorized customers. Operating security levels for AIGIS/USIGS libraries and USIGS archives may range from unclassified (U) to secret (S) to top secret/sensitive compartmented information (TS/SCI). The IGI libraries are maintained for internal exploitation and for external dissemination.

DISCOVERY SERVICES

C-26. Discovery services allow customers to research available information by searching catalogs describing AIGIS/USIGS information holdings. A global catalog enables the customers to search the holdings of multiple libraries with a single query and to receive a single, consolidated query response.

DISSEMINATION AND RETRIEVAL SERVICES

C-27. Dissemination and retrieval services allow users to obtain a copy of information maintained in AIGIS/USIGS holdings through brilliant push and pull strategies. Automated, knowledge-based information services increase responsiveness and ensure synchronization across the battle space.

ACCESS SERVICES

C-28. Access services provide a common, web-technology-based interface for accessing the services of other components. It provides a common gateway to access information stored by the A&D element's components and to request and track the creation of new information using the IM element's components. The global catalog will support discovery services by allowing users to view the contents of multiple associated AIGIS/USIGS libraries.

MEDIA-GENERATION SERVICES

C-29. Media-generation services provide capabilities supporting the generation of physical media (including film, hard-copy, and digital media). The media-generation services allow users to request the creation and delivery of media in physical form as an alternative to the electronic delivery provided directly by dissemination and retrieval services. There are four primary subelements to this element:

- **Source.** Creates and stores IGI source data for later dissemination. (Source elements include the Apache Longbow, the Advanced Tactical Air Reconnaissance System, and the Scout.)
- **Standard Products.** Provides large-volume hard-copy and electronic media reproduction and replication services.
- **Library and Archive.** Captures IGI data contained in AIGIS/USIGS libraries for distribution to customers.
- **Production.** Creates media containing information and products originating in the exploitation environment.

COMMUNICATIONS-INFRASTRUCTURE ENVIRONMENT

C-30. Communications infrastructure provides the capabilities used by the IM, C&P, exploitation, and A&D capabilities. The resources and services of the communications-infrastructure capability are provided by organizations outside of the imagery and geospatial community, and they may be shared by AIGIS/USIGS and other enterprises. Having robust, on-demand communication pathways capable of horizontal and vertical IGI information flow is critical to the successful fulfillment of AIGIS/USIGS concepts. Primary enablers include—

- **Wide-area-broadcast services.** These services support the push of information to a large footprint, allowing simultaneous broadcast to multiple recipients. This service includes the capability to tag messages and products for delivery to specific customers. It provides both continental US (CONUS) and in-theater injection points.
- **Network-security services.** These services provide the ability to protect information on the network. Multiple security methods will be used to protect the IGI in a multisecurity-level environment and allow the sharing and dissemination of the information in a work-group environment. Examples of these methods include a one-way-transfer-system (OWTS) guard for electronically moving data to a higher classification level and a one-way transfer system with a man in the loop for moving data to a lower classification level. To ensure timely passing of information, a two-way transfer system with a high-assurance guard (HAG) is necessary for electronically passing queries up and products down and across classification levels.
- **Network services.** Network services provide the interconnectivity of work stations, servers, and other components of AIGIS/USIGS operating at various classification levels.
- **Courier.** Courier services provide the local or intersite transfer of physical media for AIGIS/USIGS information and products. This may be the service of choice for passing large IGI raw data, products, and database files.

Appendix D

Database Management

The digitized Army requires current and relevant digital terrain data that will be obtained by various sensors, national resources, intelligence assets, host-nation resources, and reconnaissance forces. National agencies and topographic-engineer units will develop this data into tailored data sets, enabling the user to make strategic or tactical decisions about his battle space.

DIGITAL TERRAIN DATA

D-1. Digital terrain data must be disseminated to all C^2 systems and war-fighting entities as rapidly as possible while maintaining the data's security and ensuring that it is of the highest quality possible. War-fighting entities include dismounted soldiers, armored vehicles, and aviation assets.

D-2. To deliver this information expeditiously to the user, the desired end state must be identified. This includes terrain-data storage, manipulation (the ability to process updates), and multidimensional displays. It is necessary to first conceptualize the data sets being developed by national agencies and how they will be submitted to the users. This concept will address how terrain information and updates to the initially distributed data set are transferred back up the channels to the national agencies. Topographic-engineer units will maintain configuration-management control over the digital terrain data for their designated command.

D-3. All users of digital terrain data will adhere to the established CTOE requirements for using the data in C^2 and topographic-engineer systems. All C^2 and topographic-engineer system users will use a mapping tool kit. Based on the digital terrain data, mapping-tool-kit operators can evaluate the AO, develop a limited set of TDAs, and provide an accurate digital display of the digital terrain data.

D-4. The digital terrain data's framework will be implemented in stages varying in resolution and area coverage. The framework consists of three stages, including—

- Foundation data.
- MSDS (data generation).
- Enriched data (in-theater updates and data feeds to the maneuver battalion and below).

FOUNDATION DATA

D-5. Foundation data is the digital terrain data set initially provided to all Army units for their C^2 systems before deployment. Foundation data is based

on pre-existing data prepared by national resources for dissemination to all military users. NIMA is the primary developer of foundation data, which consists of elevation, feature, and imagery data.

D-6. NIMA's Army warehouse is the primary storage facility for Army foundation data sets. This data is available based on the unit's mission and authorization criteria. All topographic-engineer units and major commands will establish accounts to receive or retrieve periodic updates to the foundation data set (see Figure D-1). The topographic-engineer unit will manage the terrain-data file being used by the command. This will eliminate the need for all BOSs to establish accounts with NIMA. Major Army Command (MACOM) commanders may change this control based on the C^2 systems' capabilities to process and store large quantities of digital terrain data. The TI or the public internet will be considered for transferring unclassified foundation data sets from NIMA's Army warehouse to the topographic-engineer units and MACOMs.

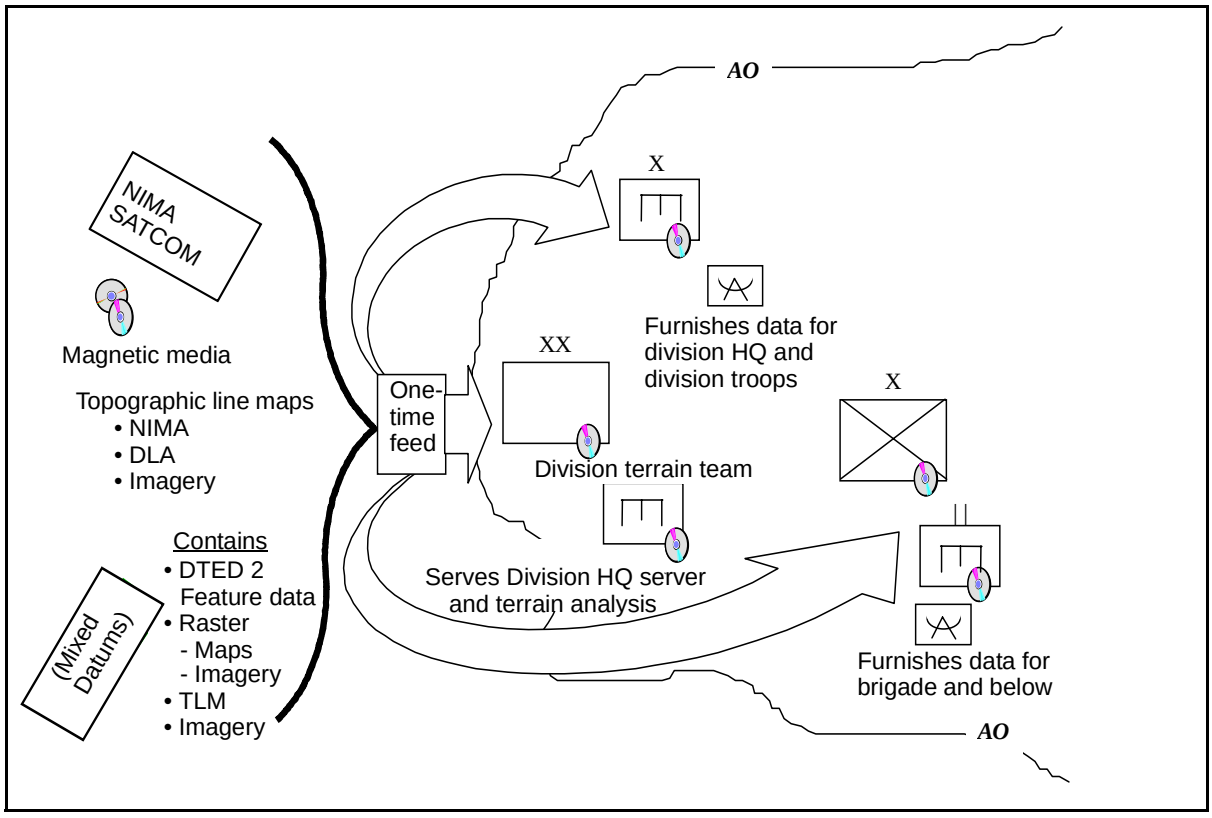


Figure D-1. Foundation Data

MSDS (DATA GENERATION)

D-7. NIMA and topographic-engineer units will provide MSDS (near-real-time data updates to the foundation data set) to C^2 systems and subordinate topographic-engineer units (see Figure D-2). The MSDS will be disseminated via established WAN systems or removable media. This MSDS will consist of

all available higher-resolution elevation data, feature-data updates, and changes affecting the terrain within the AO. This will include data acquired by national resources and sensors, host-nation assets, and in-theater real-time assets. The MSDS can be tailored to the mission and the needs of the staff.

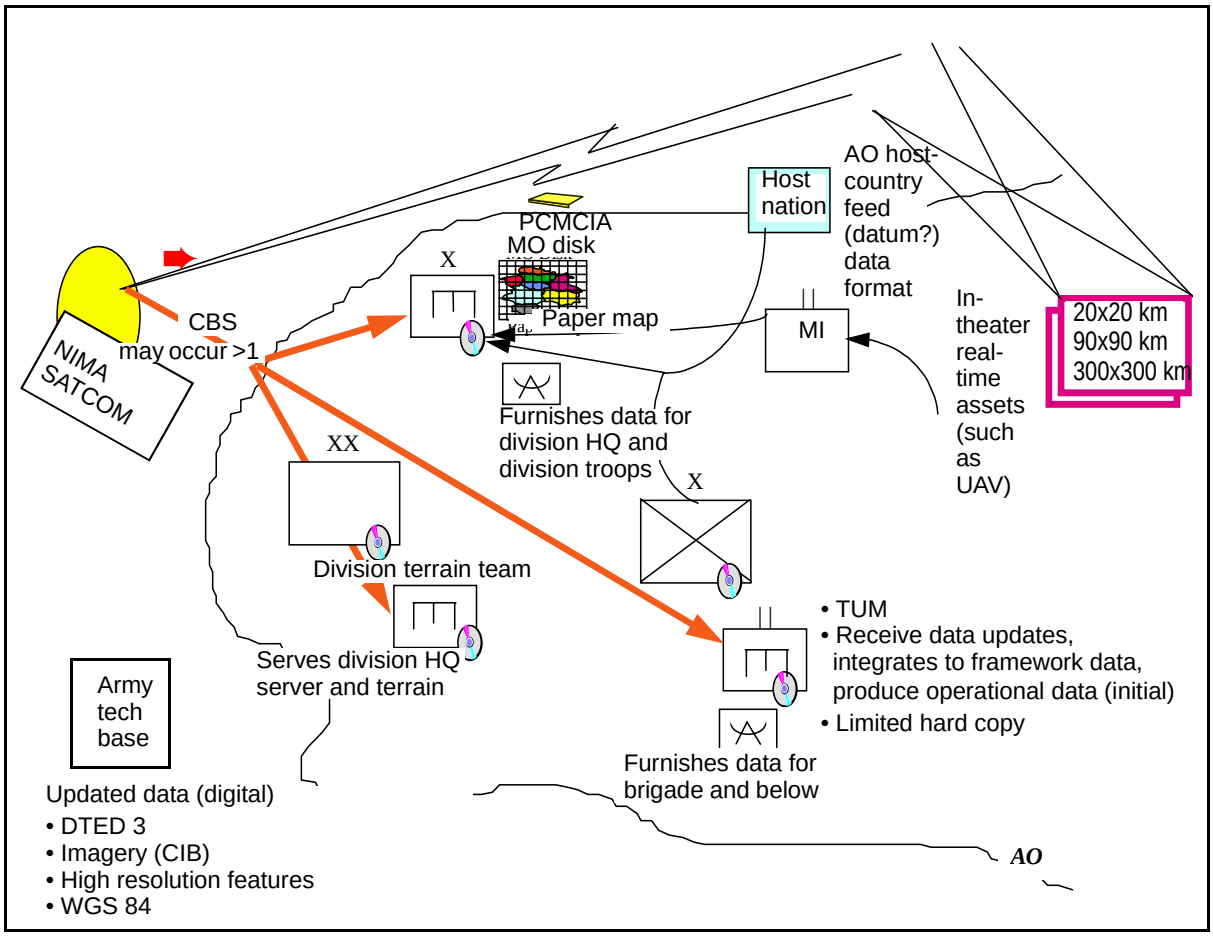


Figure D-2. MSDS

D-8. Each command's terrain-data file server will retain the MSDS for the C^2 systems. Upon receipt or generation of the MSDS, the topographic engineer will establish a command data set to be disseminated to C^2 systems via the established LAN. To command elements that are part of the LAN, designated WAN systems or removable media will be used for disseminating digital terrain data. The TI or the public internet will be considered for transferring unclassified foundation data sets from the topographic-engineer-managed terrain-data file server to C^2 systems.

ENRICHED DATA

D-9. Continuing in-theater updates and data feeds to the maneuver battalion and below is the most complicated portion of disseminating digital terrain data. This process involves moving data from higher commands to

subordinate units and from forward-deployed and possibly engaged forces to the nearest topographic-engineer unit (which may or may not have a terrain-data file server). This process is considered to begin at the maneuver brigade echelon and continues down to the war-fighting level (see Figure D-3).

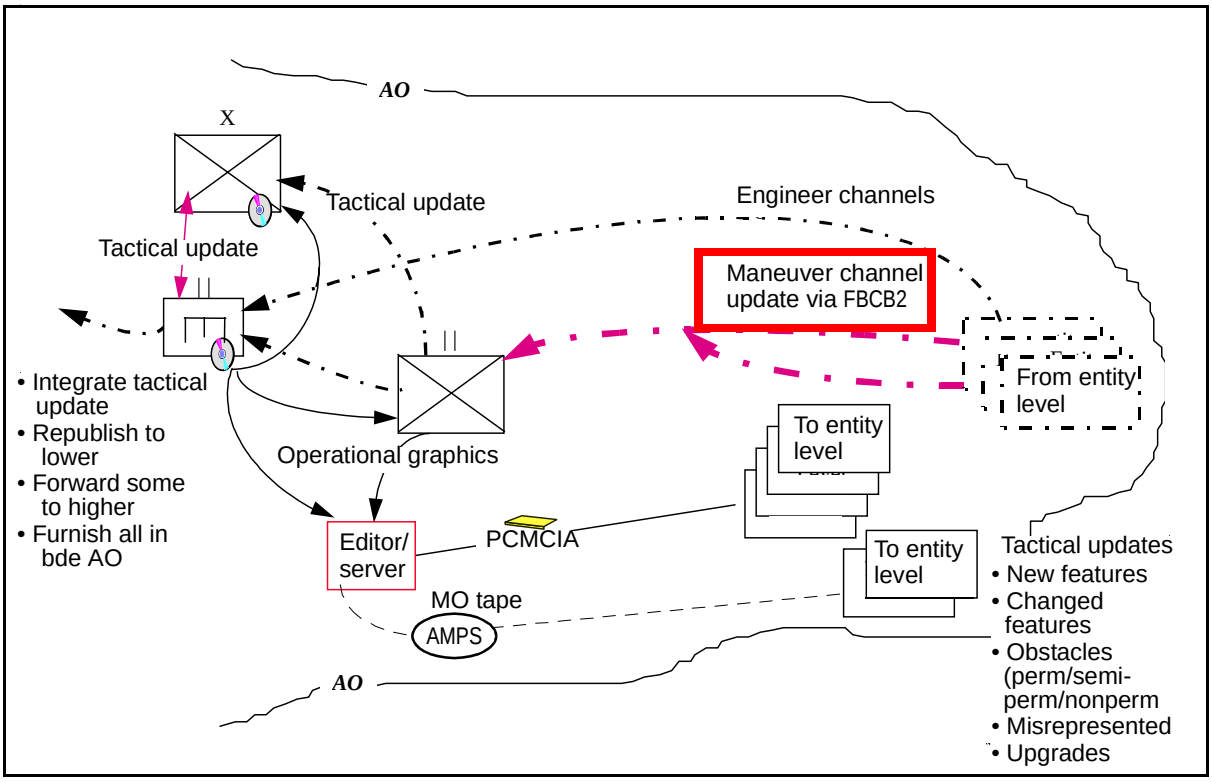


Figure D-3. Enrichment Data

D-10. At the maneuver brigade, the designated topographic-engineer element establishes and manages the foundation data set and the MSDS. Using the established tactical communications channels and removable media, the initial data is disseminated to C^2 systems and war-fighting entities. This initial data is similar to the foundation data set but is tailored for use by the war-fighting entities.

D-11. The MSDS will not be as memory intensive as the foundation data set. It is understood that these lower-echelon C^2 systems and war-fighting entities will have been provided with a tailored foundation data set by the supporting topographic engineer unit before deployment. The processing capability of C^2 systems and war-fighting entities must be robust enough to update stored data sets automatically to establish a current data set.

D-12. Tactical updates and feedback from war-fighting entities to topographic-engineer units (and eventually to NIMA's Army warehouse) are critical for providing accurate terrain products to all users. This feedback will be transferred by reversing the dissemination concept described below.

D-13. The procedure for developing and disseminating tailored data sets for the war-fighting entities crosses the boundaries of topographic-engineer

support for configuration control to logistical replication support. Based on the OPLAN, the topographic-engineer unit will develop tailored terrain data sets for war-fighting entities. The data set will be on a removable media or will be transferred via tactical communications means. It will be provided to the unit's logistics supervisor (or automation supervisor) for replication and dissemination. Based on the OPLAN, dissemination will be accomplished via the WAN or by developing removable media for the war-fighting entities.

Appendix E

Annexes

This appendix contains an outline of engineer input to OPLANs and OPORDs. Annex M (Figure E-1) states the topographic products required for completing a mission. The GI&S officer is responsible for developing this annex to the OPLAN. Figure E-2, page E-4, is a sample of Appendix 1 to the Topographic Annex.

The analysis of the AO (Figure E-3, page E-5) is the terrain-analysis unit's textual and graphic input to the OPLAN or OPORD. It can be an annex or an appendix to an annex of the OPLAN or OPORD. (Historically, it is an appendix to Annex B).

CLASSIFICATION
(Place the classification at the top and bottom of every page of the annex.)

ANNEX M, HQ OPLAN (Number)

Topographic Operations

References:

a. List the standard maps, imagery, and geospatial data that is required for an understanding of this annex.

b. List the documents that provide the guidance required for the necessary planning functions that are relevant to this annex.

1. SITUATION.

a. GI&S Requirements. List the GI&S products that are required to support this plan. Show the desired area coverage and quantitative requirements using an appendix (if necessary) or by portraying them graphically using standard index bases.

b. Available Products. Provide a general statement regarding the availability and adequacy of the GI&S data and related material required to support the plan.

c. Capabilities. List the topographic-engineer forces that are assigned or attached. Show the latest arrival date (LAD) for each topographic-engineer unit contained in the time-phased, force-deployment data (TPFDD). Use an appendix for recording detailed transportation requirements and procedures. Reference the appendix and ensure that its format follows local procedures.

d . Supporting Capabilities. List the topographic-engineer forces that are not assigned or attached but which will be required to provide topographic support needed to implement this plan, including units not deployed. Specify the type of command relationship desired for each unit and the type and duration of support required.

Figure E-1. Sample Annex M

e. Assumptions. List the assumptions upon which this annex is based. The assumptions should state expected conditions over which the commander has no control.

2. MISSION. Restate the OPLAN's mission statement.

a. Execution. Concept of topographic operations.

(1) General. Give a broad statement on how the command will provide the topographic support necessary to meet the commander's overall mission requirements. Include the—

- Time phasing of operations.
- Nature and purpose of topographic operations to be conducted.
- Support that is interrelated or cross-serviced.
- Support from the NIMA.
- Support provided by agreements, coordination, and cooperation necessary for the successful implementation of this plan. Describe the scope and extent of host-nation support (HNS) that is available to enhance topographic operations in support of the plan.

(2) Deployment. Summarize the requirements for deploying topographic-engineer forces and depot activities from their normal peacetime locations. Include the AO, emphasizing careful time planning of this deployment.

(3) Employment. Describe in general terms how deployed topographic-engineer forces are to be used to conduct topographic operations.

b. Tasks. Ensure that provisions are made for the effective operation of all topographic-engineer units supporting the command. Effective stockage and issue of GI&S products depend on timely knowledge of impending operations, threats, and command movements. Explain detailed responsibilities of commanders, staff, and topographic units. In separate numbered subparagraphs, list the topographic tasks assigned to each command element and for those units providing support to the plan. Each task should be spelled out in a concise statement, which should include a mission to be performed in terms of further planning or execution of the overall plan. These task assignments should be sufficiently detailed to ensure that all elements essential to the concept of the operation are described properly. Ensure that responsibilities are assigned to establish, validate, and submit GI&S requirements and to task topographic-engineer units supporting the plan. State responsibilities for defining and adjusting command stockage levels at map supply points. Specify map and data storage and distribution responsibilities for pickup and storage.

c. Coordinating Instructions. List those instructions that apply to the entire command or to two or more elements that are necessary for proper coordination of the GI&S support. Specify POCs within the command who can authorize the release of war-reserve stocks held or who can resolve command GI&S problems. At division level, the Division Support Command (DISCOM) operates the map supply points; at brigade level, distribution is from the forward support battalion supply company through the Supply Officer (US Army) (S4). State whether a push or pull system will be employed and specify any restrictions or quantity of the special products that may be required. Explain the command's system for setting priority and for allocating resources to deal with demands on limited resources. Include a brief description of how notification of forces and agencies will be carried out and how notification will be time sequenced. Provide the conditions under which contacts with host-nation agencies are authorized and identify those POCs.

Figure E-1. Sample Annex M (continued)

3. ADMINISTRATION AND LOGISTICS.

a. Supply and Storage.

(1) GI&S Products. Provide instructions on the GI&S supply and storage procedures and requirements. Give guidance for obtaining routine and emergency replenishment of GI&S products. Address any expected constraints on this replenishment. Include the planned locations of command and supporting GI&S storage sites and facilities. Specify the type and quantity of GI&S products to be held by the supporting command's units. Give guidance for lead times that are required for furnishing nonstandard special-purpose product support or for responding to large-quantity orders.

(2) Support of Topographic-Engineer Units. Specify the requirements needed for the provision of nontopographic as well as topographic logistics supports. (Topographic-engineer units normally rely on supported units for the majority of logistics support.)

b. Transportation.

(1) GI&S Products. Ensure that GI&S products are provided on a supply-point basis and that units needing products know they are responsible for picking up those products from established supply points. Supply guidance for the movement of GI&S products from supporting supply points to the ultimate users. List, as a minimum, the time-phased transportation-requirements list (TPTRL) portion of the TPFDD reflecting movement of GI&S materials. List any transportation shortfalls in the required support of topographic operations, and list contingency plans to fully carry out and sustain topographic operations in case full transportation requirements cannot be provided. Use an appendix (if necessary) to list detailed transportation requirements and procedures.

(2) Topographic-Engineer Units. Supply guidance for integrating the topographic-engineer unit's transportation requirements into the command's movement plan. (Topographic-engineer units may also require assistance from supported commands to move organic equipment.)

c. GI&S Support. Supply instructions for obtaining planned support. Itemize the division of responsibilities between organic units and supporting topographic-engineer units to ensure that actions to procure and stock GI&S products are complementary. Identify POCs for emergency procurement. (Access to NIMA support normally is only available through the supporting command.)

d. Reports. Specify how required reports are to be formatted as well as what time limits, methods, and classification apply to their submission. Enter this in the appendix, following local formatting procedures.

4. COMMAND AND SIGNAL.

a. Priorities. Delineate the priority of GI&S support to supported units and the priority of production for GI&S products.

b. Command Relationships. Include primary and alternate locations of all major topographic-engineer units supporting the NIMA organizations. Specify the C^2 relationships between the command and its attached or supporting topographic units and organizations if this has not previously been addressed.

c. Command and Control. Provide a statement describing the scope and types of special signal support required for topographic operations. With the exception of survey units, most topographic units have few communications capabilities. Thus, explicit tasks are assigned to ensure that these units are effectively supported by the command's assets. This is especially critical in the case of distribution platoons operating map supply points. The Communications-Electronics Annex to this OPLAN must be referenced.

Acknowledge:

Figure E-1. Sample Annex M (continued)

General
Commander in Chief

OFFICIAL:

Appendices:
1. GI&S Requirements List
2. GI&S Transportation Requirements (Optional)
3. GI&S Reports (Optional)

CLASSIFICATION

Figure E-1. Sample Annex M (continued)

CLASSIFICATION

Classified by:
Declassify on:

Headquarters, originating unit
Address
Date

Appendix 1 to Topographic Annex to HQ OPLAN (Number)

GI&S requirements list

Required Items[1]	Coverage Required[2]	Coverage Available[3]	Quantity[4]
Standard aerospace products			
Standard hydrographic products			
Standard topographic products			
Standard air-target materials			
Survey requirements			
Standard multiuse databases			

[1] A generalized description such as a map series, scale, or digital data. The stock number of a specific item is not required.

[2] Area to be covered described by geographic coordinates, political boundaries (identified by geopolitical codes), and recognizable geographic area. Display in a tab as a graphic or list.

[3] Display status in a tab as a graphic or list related to coverage required, or source for special-purpose products.

[4] Number of copies of each sheet, chart, or item needed to support the OPLAN. A list by stock number is attached as a tab.

CLASSIFICATION

Figure E-2. Sample Appendix 1 to the Topographic Annex

CLASSIFICATION

Copy no. ____ of ____ copies
Issuing headquarters
Place of issue (coordinates)
Date-time group of signature

ANALYSIS OF AO NO. 6
Reference: Map, series CSM 01, Westland, sheet 1 (Ebel), edition 1974, 1:50,000

1. PURPOSE AND LIMITING CONSIDERATIONS.

a. Purpose. To analyze and evaluate the area east of Cartersberg (9297) from the general area of Overlook Ridge (9406) south to the Erie Canal within the division zone.

b. Mission. Division attacks 140900 July, secures high ground from Hill 322 (1394) to Hill 305 (0490) to deny the enemy a bridgehead, and prepares to cross the Erie Canal and continue the attack to the south.

2. GENERAL DESCRIPTION OF THE AREA.

a. Climate or weather Conditions.

(1) Climate, Annex A (climatic summary).

(2) Weather, weather forecast, 12 through 16 July.

- Precipitation—None predicted.
- Fog—None predicted.
- Temperature—Range from 70° to 86°F.
- Wind—Surface winds from north, 9 to 17 knots per hour.
- Cloudiness—None predicted.
- Atmospheric pressure—Average about 980 millibars.
- Moon—New moon, 25 July.
- Light data.

Date	BMNT	BMCT	EECT	EENT	Moonrise	Moonset
13 July	0232	0440	1933	2138	2024	0608
14 July	0233	0442	1932	2138	2050	0714
15 July	0234	0444	1931	2137	2114	0806
16 July	0235	0446	1930	2137	2137	0901

b. Terrain.

(1) Relief and drainage systems. Annex B (Relief Overlay), Annex C (Drainage Overlay), and Annex D (Slope Overlay). Area is drained by the Maine River on the west and southwest and the South River on the northeast. The northwest to southeast ridge running from Hill 351 (9807) to Albany (3960) generally bisects the area. The major spurs of this ridge run generally east and west. The terrain is generally rolling with a series of sharply rising tablelands. The Maine and South Rivers and the Erie Canal are unfordable. The Maine River south of Cartersberg averages about 30 meters in width and 2 meters in depth. The South River averages about 15 meters in width and 2 meters in depth. The Erie Canal has steep banks and averages about 3 meters in depth and is about 17 to 21 meters in width at the top of the banks. All other rivers and streams are fordable, varying in width from 1 to 7 meters, with an average depth of 40 centimeters.

Figure E-3. Sample Analysis of the AO

(2) Vegetation. Annex E (Vegetation Overlay) and Annex F (Vegetation Impeding Movement Overlay). Vegetation consists of growing crops, vineyards, pasturelands, orchards, and wooded areas. Hay, wheat, and vegetables are the main crops. Most crops are completely cut by the end of September. Wheat is grown mostly on open-topped tablelands. Vineyards are generally terraced and on the slopes of the hills. Most woods in the area are made up of deciduous trees about 25 centimeters in diameter and about 10 to 12 meters apart. Underbrush has been cleared throughout the area. Logging operations throughout the forest in the vicinity of 9306 have thinned the tree stand to an average density of 90 trees per hectare. Roads and stream banks are generally bordered with trees. Small, scattered patches of trees are found in the lowland plains. Wooded areas restrict, but do not preclude, the employment of armor.

(3) Surface Materials. Annex G (Soils Overlays). Surface in most of the area consists of thick clay-like soil on hard limestone or a limey-shale base. Above 200 meters elevation, with but few exceptions, the soil is firm and capable of supporting heavy wheeled and tracked vehicles even when under cultivation. The rains do not seriously affect trafficability at this time of year. The soil is generally wet in stream bottoms and in the lowlands below 200 meters elevation. While capable of supporting light tracked or wheeled vehicles, the soil becomes spongy and boggy where the turf has been destroyed.

(4) Artificial Features. Annex H (Builtup Areas and LOC Overlay). A double-track railroad crosses the area from Cartersberg to the east. A single-track railroad runs from Nome (9619) to Cartersberg, crossing the Macon saddle (9608). A double-track railroad from the west parallels the south bank of the Erie Canal as far as Dawson (0489). The area is covered with an extensive network of principal and secondary roads. Principal roads radiate from Cartersberg. Roads across Overlook Ridge (9406) from north to south have been improved. National highways are at least 6 meters wide. All bridges on regularly maintained roads are two-way Class 50. Villages consist of closely grouped buildings of brick or stone. The enemy has constructed extensive field fortifications and artificial obstacles throughout the area north of Erie Canal. The artificial obstacles consist primarily of minefields and wire and are most extensive in the South River valley and in the general area of Athens (0194) and Auburn (0495).

c. Other Characteristics.

(1) Sociology. The area is generally rural. The farm villages have a present population of 50 to 100 each. The current population of Cartersberg is estimated at 50,000 and the population of Harlow is estimated at 15,000. The population is primarily caucasian; farming is the principal occupation. Principal crops are wheat, corn, cotton, and grapes.

(2) Economics. Little food and few supplies are available because the enemy has taken food and materials to support the forces. However, some grain crops remain in the fields and can be harvested at a later date if protected.

(3) Government. Civil agencies are prepared to take over functions of civil governments as the country is recaptured.

(4) Psychology. The confiscation of food and supplies and the impressing of civilian labor have made the people extremely hostile toward the enemy. Acts of sabotage occur frequently in the Army's rear area.

3. MILITARY ASPECTS OF THE AREA.

a. Tactical Aspects.

(1) Observation and fire. Annex I (Horizontal Visibility Overlay).

- Weather conditions. Annex J (Fog Overlay). Weather permits good air and ground observation. Continued dry weather will increase dust clouds caused by nuclear weapons. Observation will be reduced for a longer period of time in nuclear target areas. Weather favors our, but not the enemy's, use of smoke.

Figure E-3. Sample Analysis of the AO (continued)

- Relief. The high ground now held by the enemy affords the enemy excellent observation over approaches into the position. The enemy-held hills west of the Maine River dominate the western part of the area. High ground in the vicinity of Balda's Peak (0004) provides the enemy with excellent observation to the northeast, east, and south. The division objective, with the spur extending north from 1395 to 1004, provides the enemy with excellent observation over all approaches leading to it. Fields of fire within the area for flat-trajectory weapons are generally good but short, except in valley bottoms and from the military crests of open hilltops where they are generally excellent. Fields of fire on the northern slopes of Overlook Ridge and Hill 351 are excellent and favor enemy defense. Fields of fire from the northern slopes of the division objective are excellent. Long-range fields of fire to the south from Overlook Ridge are good and favor our attack. Fields of fire for high-angle weapons are good throughout the area.

- Vegetation. The National Forest from 0306 to 0597 severely restricts observation and fields of fire in the eastern part of the area. Within all wooded areas, fields of fire for flat-trajectory weapons are restricted in forest trails and roads. Fields and tree blowdown in woods, caused by nuclear weapons, may restrict fields of fire within woods. Wheat fields severely restrict ground-level observation this time of the year. Forest-fire smoke clouds may reduce observation throughout the area.

- Artificial features. Church steeples in the numerous villages afford excellent observation points. Villages and farm buildings will limit fields of fire for flat-trajectory weapons.

(2) Concealment and cover.

- Relief. The rolling nature of the terrain affords some degree of concealment and cover from ground observation. Concealment and cover are poor on the northern slopes of Overlook Ridge and Hill 351. On the southern slopes of Overlook Ridge, concealment and cover are good. The rolling nature of the terrain and numerous folds in the ground will reduce thermal effects of nuclear bursts.

- Vegetation. Annex K (Canopy Closure Overlay). The National Forest offers excellent concealment and cover for large units. Woods throughout the area afford excellent concealment and protection from thermal effects because of the thick deciduous trees being in full leaf. Wheat fields also afford some degree of concealment.

- Artificial features. Buildings in the area offer cover from small-arms fires and shell fragments but do not protect from blast by any significant degree.

(3) Obstacles. Annex L (Combined Obstacles Overlay).

- Relief. Terrain favors enemy use of persistent chemicals in the valley forward of the present position. The drainage system consists of the Maine and South Rivers.

- Vegetation. Woods, especially the National Forest, will restrict the cross-country mobility of all vehicles, including track-laying vehicles. The woods will become severe obstacles in the event of blowdown by blast or if set afire. Cultivated areas will limit wheeled vehicles. Terraced vineyards on the south slopes of Overlook Ridge, Bald Peak at 9400 northeast of Cartersberg, will restrict the movements of tanks and heavy vehicles to road and trails in those areas.

- Surface materials. Annex M (Weather Effects on Cross-Country Movement Overlay). The soil is generally wet in areas below 299 meters elevation. This will magnify the cratering effects of subsurface nuclear bursts in these locations. While capable of supporting light tracked or wheeled vehicles, the soil becomes spongy and boggy where the turf has been destroyed. Soil composition does not favor the production of high intensities or radioactivity.

Figure E-3. Sample Analysis of the AO (continued)

- Artificial features. The enemy has constructed extensive artificial obstacles consisting of minefields and wire, particularly on the east flank and north of Hill 305 (0490). This will hinder movements and limit the use of certain avenues of approach (AAs) in these areas. Buildings and villages do not present significant obstacles even if destroyed by blast, except for the suburbs of Cartersberg on the east bank of the Maine River.

(4) Key terrain features.

- Hill 351 (9807) and Overlook Ridge west thereof. These terrain features control the AAs in the western and central parts of our zone. The mission will be seriously jeopardized if these areas are not secured.

- Hill 359 (0004). This hill mass dominates the central and eastern AAs. Its seizure is essential to the integrity and security of our forces and will facilitate fire and maneuver to the south.

- Hill 334 (9400). This plateau controls the AAs in the western part of the division zone. It is key terrain if our tactical plans call for either a main attack or a supporting attack in the area.

- Hill 306 (9997). This hill provides dominant observation over a wide area in this part of the division zone. Its seizure and control will greatly enhance the security, fire, and maneuver of any forces attacking in this area.

- Hill 326 (1199). This hill dominates favorable terrain leading directly into the eastern part of the division objective.

- Hills 305 (0490) and 322 (1394). This terrain system constitutes the division objective. The mission cannot be accomplished without securing it. Control of this ridge is also necessary to continue the attack to the south.

(5) Avenues of Approach. Annex N (Avenues of Approach Overlay).

- Available to enemy in our position.

  — Axis Hill 351 (9807)–Hill 361 (9709).

  — Axis Hill 339 (9206)–Hill 358 (9310).

  — Axis Hill 280 (0010)–Paris (9811)–Hill 354 (9613).

- Available to us in the enemy's position.

  — Axis Hill 358 (9310)–Hill 339 (9206)–Hill 334 (9400)–Hill 306 (9997)–Hill 305 (0490)–ridge east thereof (Avenue A).

  — Axis Hill 361 (9709)-Hill 351 (9807)-Hill 359 (0004)-Auburn (0495)-ridge Hill 305 (0490) to Hill 322 (1394) (Avenue B).

  — Axis Hill 361 (9709)-Hill 351 (9807)-Hill 359 (0004)-Hill 271 (0702)-Hill 326 (1199)-Hill 322 (1395)-ridge west thereof (Avenue C).

  — Axis Hill 280 (0010)-Hill 282 (0803)-Hill 326 (1199)-Hill 322 (1394)-ridge west thereof (Avenue D).

Figure E-3. Sample Analysis of the AO (continued)

b. CSS Aspects.

(1) Personnel. Characteristics of the society are such that only unskilled civilian labor will be available at any time. Employment of civilian labor to meet short-term objectives must be balanced carefully against the long-term needs of harvesting crops.

(2) Logistics. Lack of civilian food and supplies may impose added logistics burdens on our forces. Some pilferage can be expected. Few resources beyond basic natural resources are available for military use.

(3) Civil-military operations. Displacement of civilians through the impressing of civilian labor by the enemy and lack of food and supplies will create problems that, if not controlled, can impact military operations. The existence of civil agencies capable of assuming the functions of government will help alleviate the problem. However, these agencies will require guidance.

4. EFFECTS OF CHARACTERISTICS OF THE AREA.

a. Effect on Enemy COAs.

(1) Effect on enemy defense.

- Terrain now held by the enemy favors defense in depth from present positions to the division objective. The enemy has excellent observation over all AAs, and the enemy's flanks are protected by the rivers and canal on the west and artificial obstacles on the east. The enemy's best defense areas are the enemy-occupied forward positions.
- The excellent weather conditions favor enemy defense and permit the enemy to use supporting fires with maximum effectiveness.

(2) Effects on enemy attack.

- The enemy's best AA is the axis Hill 280 (0100)-Paris (9811)-Hill 354 (9613).
- Weather conditions are such that the enemy will not be able to maneuver toward our positions without being observed except during the hours of darkness. The lack of precipitation favors cross-country mobility.

(3) Effect on enemy air.

- Weather and terrain favor enemy employment of air in the division's AO.
- Terrain favors enemy delivery of nuclear weapons by low-level air attack.

(4) Effect on enemy use of nuclear weapons. Weather conditions are favorable for enemy use of nuclear weapons. Effective winds do not favor use of fallout. Rolling terrain, numerous folds in the ground, and foliage will reduce thermal effects. Obstacles will be created by forest and tree blowdown.

(5) Effect on enemy chemical operations. Weather does not favor enemy use of chemicals. Terrain favors use of persistent chemicals in the valley forward of the enemy's present defensive positions.

b. Effect on Own COAs.

(1) The best natural AA into the enemy area is axis Hill 280 (0010)-Hill 232 (0803)-Hill 326 (1199)-Hill 322 (1394)-ridge west thereof (Avenue D); it is blocked by extensive minefields.

Figure E-3. Sample Analysis of the AO (continued)

(2) The second best AA is axis Hill 361 (9709)-Hill 232 (0803)-Hill 326 (1199)-Hill 322 (1394)-ridge west thereof (Avenue A).

(3) Weather and terrain does not favor our attack. We will not be able to maneuver toward enemy positions without being observed except during hours of darkness. The lack of precipitation will favor cross-country mobility except below 200 meters elevation. Forest fires and tree blowdown caused by use of nuclear weapons in the National Forest will restrict mobility, observation, and fields of fire.

(4) Effect on nuclear weapons. Weather conditions are favorable for the employment of nuclear weapons. The rolling nature of the terrain, numerous folds in the ground, and foliage will reduce the effects on nuclear bursts. The wooded areas are dry and subject to extensive burning. Soil composition does not favor the production of high intensities of radioactivity. Winds generally favor employment by our forces of radiation effects of fallout from nuclear weapons.

(5) Effect of chemical agents. Weather conditions are favorable for our use of chemicals.

Acknowledge:

Commander's last name
Rank

OFFICIAL:
(Authentication)

Annexes:
A - Climatic Summary (omitted)
B – Relief Overlay (omitted)
C – Drainage Overlay (omitted)
D – Slope Overlay (omitted)
E – Vegetation Overlay (omitted)
F – Vegetation Impeding Movement Overlay (omitted)
G – Soils Overlay (omitted)
H – Built-up Areas and LOC Overlay (omitted)
I – Horizontal Visibility Overlay (omitted)
J – Fog Overlay (omitted)
K – Canopy Closure Overlay (omitted)
L – Combined Obstacles Overlay (omitted)
M – Weather Effects on Cross-Country Movement Overlay (omitted)
N – Avenues of Approach Overlay (omitted)

Distribution: A

CLASSIFICATION

Figure E-3. Sample Analysis of the AO (continued)

Appendix F

Legacy Systems

The Topographic Support System (TSS) includes COTS equipment used by topographic battalions (including their organic topographic companies) and theater, corps, and division terrain teams. The system is housed in twenty-three 30-foot containers and a 20-foot truck-mounted van unit. Several modules and van configurations make up the seven functional subsystems.

CARTOGRAPHIC-REVISION SUBSYSTEM

F-1. The Cartographic-Revision Subsystem prepares final drawings and reproduction materials for special-purpose graphics, drafts original overlays, and revises existing overlays cartographically and photographically for general-purpose graphics. This subsystem consists of a drafting and a compilation section.

F-2. The drafting section produces the set type, analyzes topographic products, and creates precision drawings, grids, masks, and pin registrations. The compilation section performs cartographic scribing, prepares drafts and map manuscripts, annotates photography, and produces overlays and overprint material.

IMAGE-BASED PRODUCTS SUBSYSTEM

F-3. The Image-Based Products (IBP) Subsystem performs all photographic processing and transformations required including differential and frame rectification, mosaicking, scale changes, and routine photographic reproduction. It consists of the rectifier I and II sections and the mosaicking/ drafting section.

F-4. The rectifier I section provides a facility for rectified and unrectified prints and film from roll or sheet-film images and for processing exposed film for use in the overall system. The rectifier II section provides a facility for editing and annotating photographic prints. It provides ground coordinates, elevation, and dimensions derived from aerial photographs. This section also exercises quality control over the rectifier I section and safeguards topographic data.

F-5. The mosaicking/drafting section assembles mosaics for photographic map production. It also drafts maps and map products.

STORAGE AND DISTRIBUTION SUBSYSTEM

F-6. The Storage and Distribution Subsystem provides a central location for storing TSS data-bank material. It also maintains a system for locating and retrieving materials. This subsystem also completes the packaging (trimming, binding, and folding), forwards the product, and destroys sensitive material. It consists of the storage and distribution sections.

F-7. The storage section stores and retrieves the unit's basic load of topographic data. The distribution section maintains and issues standard map products from limited stock and disposes of obsolete map products.

REPRODUCTION SUBSYSTEM

F-8. The Reproduction Subsystem provides the capability to perform all required sequential functions necessary for reproducing lithographic products. It consists of seven sections—the photomechanical, camera, layout, platemaking, press, finishing, and paper-conditioning sections.

F-9. The photomechanical section prepares proof copies for editing, processes manuscript images on plastic scribing materials or blueprints, prepares duplicate reproduction materials, and processes exposed film. The camera section produces negatives from color-separated original manuscript (including continuous tone, halftone, and line copy), performs reduction to 33 percent and enlargement to 300 percent, and processes all exposures. The layout section provides engraving, opaquing, and laying out processed negatives for producing maps, photomaps, and map substitutes. It also performs precision checking and retouches flats.

F-10. The platemaking (plate-processing) section processes lithographic offset plates by exposing, developing, and preparing items for the press section. The press section produces multiple copies of required products in either monochrome or color. The finishing section prepares paper stock for printing, completes reproduced products by trimming and binding, packages the completed products for distribution, and shreds obsolete and classified products. The paper-conditioning section climatically stabilizes paper by maintaining a constant temperature and humidity that will be encountered when the paper is printed in the press section.

C^2 SUBSYSTEM

F-11. The C^2 Subsystem provides centralized control, direction, and management of the overall functions. It also provides the maintenance for the TSS. This includes processing external requests, defining requirements, assigning internal priorities, and managing operational activities. This subsystem consists of an operations and a maintenance section.

F-12. The operations section centralizes control, direction, and production management for all of the TSS. The maintenance section is responsible for repairing and maintaining all unique survey, cartographic, and reproduction equipment within the TSS.

MILITARY GEOGRAPHIC INFORMATION SUBSYSTEM

F-13. The Military Geographic Information (MGI) Subsystem provides a storehouse and center for on-site terrain data collection, analysis, and synthesis for topographic support. It consists of five sections—the collection, information, synthesis, analysis, and DS sections.

F-14. The collection section collects all basic MGI from all possible sources. It catalogs all data received and passes it to the analysis section for processing or to the information section for storage. The collection section monitors requests for data collection that must be sent to units outside the TSS. It also collects MGI for other TSS sections. The collection section serves as the focal point for supervising TSS operations.

F-15. The information section is responsible for the receipt, accountability, and storage of processed MGI. It also disseminates information as required. The synthesis section provides graphic or textual analyses from factor overlays and other TSS data to meet military requirements. The analysis section interprets, evaluates, and updates MGI. The DS section provides a quick-reaction capability for collecting, analyzing, cataloging, and retrieving information. It also furnishes military geographic support as required.

DOWNSIZED DIRECT-SUPPORT SYSTEM

F-16. The Downsized Direct-Support System (DDSS) provides a downsized version of the DS section of the TSS to meet the close combat light forces' mission requirements for transportability and deployment. The DDSS colocates with the division tactical operations center (DTOC). The DDSS consists of a 5/4-ton truck with a standard shelter; it tows a 3/4-ton trailer. Upon deployment, a tent is erected from the rear of the shelter to provide 80 percent of the operational work area.

DIGITAL TOPOGRAPHIC SUPPORT SYSTEM—LOW-RATE INITIAL PRODUCTION

F-17. The Digital Topographic Support System—Low-Rate Initial Production (DTSS-LRIP) is an automated tactical terrain data system featuring hardware and software modularity and using electronic data processing and computer technology. It provides input for the IPB, TDAs, and terrain data management for the AO. The system receives, reformats, creates, stores, retrieves, updates, manipulates, disseminates, and densifies digital terrain data.

SURVEY SUBSYSTEM

F-18. The Survey Subsystem establishes new or additional basic networks of control. It also determines the position, elevation, and azimuth at required points and at the required accuracy.

Glossary

3-D	three dimensional
A&D	archive and dissemination
A^2C^2	Army Airspace Command and Control
AA	avenue of approach
AAN	Army After Next
AASHTO	American Association of State Highway and Transportation Officials
ABCS	Army Battlefield Command System
ACD	automated change detection
ACDB	ABCS common database
ACE	assistant corps engineer
ACR	advanced concepts and requirements
AD	air defense
ADA	air-defense artillery
ADC-M	assistant division commander-maneuver
ADE	assistant division engineer
ADRG	arc digitized raster graphic
AFATDS	Advanced Field-Artillery Tactical Data System
AFE	assisted/automated feature extraction
AGL	above ground level

AIGIS Army Imagery and Geospatial Information and Services

AISI automatic integrated survey instrument

AMDWS air- and missile-defense workstation

AMPS Aviation Mission Planning System

AO area of operation

AOI area of interest

AR Army regulation

ARFOR Army forces

ARSPACE Army Space Command

ASAS All-Source Analysis System

ASAS-RWS All-Source Analysis System-Remote Work Station

ASCC Army Service Component Command

ATR assisted/automated target recognition

attn attention

BCV battle-command vehicle

bde brigade

BMCT begin morning civil twilight

BMNT begin morning nautical twilight

BOS battlefield operating system

BSM battlefield-spectrum management

C^2 command and control

C^2I	commercial/civil imagery
C^2V	command and control vehicle
C^3	command, control, and communications
C^4I	command, control, computers, communications, and intelligence
C&P	collection and processing
CAC	compressed aeronautical chart
CAD	computer-aided design
CADRG	compressed ADRG
CBR	chemical, biological, and radiological
CBS	corps battle simulation
CCIR	commander's critical information requirements
CCM	cross-country movement
CD-ROM	compact disk—read-only memory
CIA	Central Intelligence Agency
CIB	controlled image base
CINC	commander in chief
cm	centimeter(s)
Co	company
COA	course of action
COMSEC	communications security
CONPLAN	contingency plan

CONUS continental United States

COTS commercial off-the-shelf

CP command post

CS combat support

CSS combat service support

CSSCS Combat-Service-Support Control System

CTIS Combat Terrain Information System

CTOE common topographic operating environment

CWO chief warrant officer

DA Department of the Army

dB decibel(s)

DBMS Database Management System

DCSINT Deputy Chief of Staff for Intelligence

DCSOPS Deputy Chief of Staff for Operations and Plans

DDSS Downsized Direct-Support System

deg degree(s)

DFAD digital feature-analysis data

DGPS differential global positioning system

DIA Defense Intelligence Agency

DISA Defense Information Systems Agency

DISCOM Division Support Command

DISN Defense Information Systems Network

dist distribution

DIVARTY division artillery

DIVEN division engineer

DLA Defense Logistics Agency

DMA Defense Mapping Agency

DMAFF DMA Feature File

DMAIN division main

DMS Defense Mapping School

DOD Department of Defense

DODAAC Department of Defense activity address code

DPPDB digital point position database

DS direct support

DTAC division tactical-analysis cell

DTED digital terrain-elevation data

DTLOMS doctrine, training, leader development, organization, materiel, and soldiers

DTOC division tactical operations center

DTSS Digital Topographic Support System

DTSS-B Digital Topographic Support System-Base

DTSS-D Digital Topographic Support System-Deployable

DTSS-H Digital Topographic Support System-Heavy

DTSS-L Digital Topographic Support System-Light

E east

E5 sergeant

E6 staff sergeant

E7 sergeant first class

EAC echelons above corps

EAD echelons above division

EBA engineer battlefield assessment

EECT end evening civil twilight

EENT end evening nautical twilight

EM enlisted member

ENSIT enemy situation

ERDC Engineer Research and Development Center

ETI environmental threshold and impact

FA field artillery

FAADC^2 Forward-Area Air-Defense System for Command and Control

FBCB^2 Force XXI Battle Command—Brigade and Below

FD foundation data

FFD foundation feature data

FFED fire-finder elevation data

FLIP flight-information publication

FM field manual

FOC future operational capabilities

FS fire support

FSCOORD fire-support coordinator

G2 Assistant Chief of Staff, G2 (Intelligence)

G3 Assistant Chief of Staff, G3 (Operations and Plans)

GCCS Global Command and Control System

GCCS-A Global Command and Control System-Army

GCCS-T Global Command and Control System-Tactical

GGI&S global geospatial information and services

GI geospatial information

GI&S geospatial information and services

GID Geospatial Information Division

GIF graphics interchange format

GIS Geographic Information System

GNC global navigation chart

GOTS government off-the-shelf

GPS Global Positioning System

GS general support

HAG high-assurance guard

HET heavy equipment transporter

HHC headquarters and headquarters company

HLZ helicopter landing zone

HMMWV high-mobility, multipurpose wheeled vehicle

HNS host-nation support

HQ headquarters

HQDA Headquarters, Department of the Army

hr hour(s)

HUMINT human intelligence

IBP image-based products

ICM information-collection management

ICS^3 Integrated Combat-Service-Support System

IDM information-delivery management

IEW intelligence and electronic warfare

IFSAR interferometric synthetic aperture radar

IGI imagery and geospatial information

IHO International Hydrographic Organization

IM information management

IMETS Integrated Meteorological System

IMINT imagery intelligence

info information

intel intelligence

IPB intelligence preparation of the battlefield

IPM information-production management

IRM information-requirements management

ISO international standards organization

ISYSCON Integrated Systems Control

ITD interim terrain data

J2 Intelligence Directorate

JNC jet navigation chart

JOPES Joint Operational Planning and Execution System

JOG joint operational graphic

JTF joint task force

km kilometer(s)

kph kilometer(s) per hour

LAD latest arrival date

LAN local-area network

liq liquid

LOC lines of communication

LOS line of sight

LRAS Long-Range Acquisition System

LRIP low-rate initial production

m meter(s)

M&S modeling and simulation

M/S mobility/survivability

MACOM Major Army Command

MANSCEN US Army Maneuver Support Center

MASINT measurement and signature intelligence

mb millibar(s)

MCOO modified combined-obstacle overlay

MCS Maneuver Control System

MDMP military decision-making process

METT-TC mission, enemy, terrain, troops, time available, and civilian consideration

MGI military geographic information

mgmt management

MI military intelligence

MO magneto optical

MOU Memorandum of Understanding

MP military police

MSBL Maneuver Support Battle Laboratory

MSC major subordinate command

MSDS mission-specific data set

MSL mean sea level

MTC movement to contact

N	north
NATO	North Atlantic Treaty Organization
naut	nautical
NAVSTAR	Navigation Satellite Timing and Ranging
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
NE	northeast
NIMA	National Imagery and Mapping Agency
NIMC	National Imagery and Mapping College
No.	number
nonperm	nonpermanent
NRMMII	NATO Reference Mobility Model II
NSN	national stock number
NW	northwest
obs	obstacle
OCOKA	observation and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach
OIC	officer in charge
ONC	operational navigation chart
OPLAN	operation plan
OPORD	operations order
OWTS	one-way transfer system

P&C	planning and control
Pam	Pamphlet
PCMCIA	Personal Computer Memory Card International Association
PEOC^{3}S	Program Executive Office for Command, Control, and Communications Systems
perm	permanent
PIR	priority intelligence requirements
PLGR	precise lightweight GPS receiver
POC	point of contact
POL	petroleum, oil, and lubricants
PPS	Precise Positioning Service
prod	production
PTADB	planning terrain-analysis database
R&S	reconnaissance and surveillance
RDA	research, development, and acquisition
repro mats	reproduction materials
S	secret
S	south
S2	Intelligence Officer (US Army)
S3	Operations and Training Officer (US Army)
S4	Supply Officer (US Army)
SCP	survey control point

SE southeast

sec section

semiperm semipermanent

SIC survey information center

SMDC US Army Space and Missile Defense Command

SOF special operations forces

SOP standing operating procedure

SPCE survey planning and coordination element

spec special

SPPB special-purpose product builder

STAMIS Standard Army Management Information System

stat statute

SW southwest

SWO staff weather officer

TAC tactical command post

TACDAM tactical dam analysis

TDA tactical decision aid

TDL theater downlinked

TEC Topographic-Engineering Center

tech technical

TEMO training, exercises, and military operations

TF task force

TI Tactical Internet

TLM topographic line map

TO theater of operations

TOC tactical operations center

TOE tables of organization and equipment

TPC tactical pilot chart

TPED tasking, production, exploitation, and dissemination

TPFDD time-phased, force-deployment data

TPIO TRADOC Program Integration Office

TPTRL time-phased, transportation-requirements list

TRADOC US Army Training and Doctrine Command

TS/SCI top secret/sensitive compartmented information

TSS Topographic Support System

TTP tactics, techniques, and procedures

TUM terrain update module

U unclassified

UAV unmanned airborne vehicle

US United States

USACE US Army Corps of Engineers

USAES US Army Engineer School

USAF US Air Force

USGS US Geological Survey

USIGS US Imagery and Geospatial Information Services

UTM universal transverse mercator

VCI vehicle cone index

V.E. vertical exaggeration

veg vegetation

VIS visibility

VITD vector interim terrain data

W west

WAN wide-area network

WES Waterways Experiment Station

WGS World Geodetic System

WIN War-Fighter Information Network

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By Order of the Secretary of the Army:

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